

## **New species of *Holoparasitus* Oudemans, 1936 (Acari, Parasitidae) from Spain, North Africa, the Canary and Madeira Islands**

Ilinca JUVARA-BALS

Muséum d'histoire naturelle, CP 6434, CH-1211, Genève 6, Switzerland.

E-mail: ibals@bluewin.ch

**New species of *Holoparasitus* Oudemans, 1936 (Acari, Parasitidae) from Spain, North Africa, the Canary and Madeira Islands.**- Fourteen new species of *Holoparasitus* Oudemans are described: *H. mahnerti*, *H. vaucheri*, *H. franzi*, *H. variabilis*, *H. canariensis*, *H. anaga*, *H. lapalma*, *H. giganteus*, *H. lunae*, *H. malleus*, *H. rifensis*, *H. algiersensis*, *H. eivissa*, and *H. singularis*. All these are included in the *Holoparasitus mallorcae* species-group sensu Juvara-Bals & Witalinski (2000) and were collected from south Spain, Morocco, Algeria, the Balearic, the Canary and Madeira Islands. A key to the species of this group is presented. Comments on the relationship between these species and some observations on their geographical distribution are given.

**Keywords:** Acari - Gamasida - Parasitidae - taxonomy - key.

### **INTRODUCTION**

The predatory soil mite *Holoparasitus* Oudemans, 1936 has been the subject of many studies in the last decade. New taxa have been described, the species from the collection of Berlese have been revised, and neotypes have been designated (Juvara-Bals & Witalinski, 2000; Witalinski, 1994a, 1994b; Witalinski & Skorupski, 2002, 2003).

I analysed numerous soil samples and specimens from the Gamasida collection in the Museum of Natural History of Geneva (MNHG) and discovered 14 new species belonging to the *H. mallorcae* species-group sensu Juvara-Bals & Witalinski, 2000. This species group has a surprisingly high diversity. *Holoparasitus mallorcae* Juvara-Bals, 1975 was found of new localities (Balearic Islands and Spain), therefore an analysis of the variability of some features was possible. This has led to a better understanding of the characteristics of this species and has helped delimit their variability within and between populations. The purpose of this paper is to describe the new taxa and to analyse their distribution. I am aware that the species presented herein are only a small part of the many undescribed species of this strongly diversified genus *Holoparasitus*.

The diagnoses of the different species groups, as defined by different authors (Micherdzinski, 1969; Juvara-Bals, 1975; Juvara-Bals & Witalinski, 2000; Witalinski & Skorupski, 2002, 2003; Juvara-Bals & Witalinski, 2006) will probably be better

understood and modified, in time, after further investigation of *Holoparasitus* material from additional parts of the Palearctic region.

## MATERIAL AND METHODS

The material used in this study is part of the Gamasida collection of the Natural History Museum of Geneva, Switzerland (MNHG) which includes the collection of C. Athias-Henriot. Prof. H. Franz (H.F.) sampled material from Spain, Portugal, Morocco, the Canary, the Balearic and Madeira Islands. C. Athias-Henriot (A-H), C. Besuchet (C.B.), B. Hauser (B.H.) and I. Löbel (I.L.) have collected mites from various other localities. Localities labelled in this text by initials followed by a number refer to material from the Athias-Henriot collection.

The morphological terminology follows the one established by Evans & Till (1979), the setal notation for the idiosoma that of Lindquist & Evans (1965) with modification of the opisthogaster as given by Lindquist (1994).

I selected some morphometric characters of the female in order to differentiate better these closely related species. The measurements were taken as follows: epigynium height (h) represents the midline from the tip of the shield to the posterior margin and its basal width (b) is the length of the posterior margin of the epigynium; ratio h/b indicates the proportion between the height and the width of the epigynium (Fig. 3J); setae distance *st-st'* was measured between the two setae of the pair *st* inserted on the sternal and epigynial shields. For the endogynium, characterized by two protrusions on its posterior margin, the following parameters were taken: height of the protrusion (a) and basal distance between the protrusions (b) (Fig. 2K). Length of the idiosoma, of the peritreme, of tarsus I and IV (of both sexes) indicate the size of the mites.

A compilation of morphometric values (in micrometers) is given in table I.

All types are deposited in the MNHG.

## SYSTEMATIC ACCOUNT

### *Holoparasitus mallorcae* species-group

All species treated in this paper belong to the *H. mallorcae* species-group and share the following morphological characters.

The idiosoma is strongly sclerotized, yellow brownish in colour; the colour depends on the age of the mite, young specimens are more yellowish and older ones became brown reddish. On the dorsal side the longest setae are on the podonotum and their lengths decrease towards the posterior margin of the opisthonotum, some being shorter than 10  $\mu\text{m}$ . The opisthogaster has eight pairs of ventral setae and three circumanal setae. The gland pore *gv1* located under the seta *st3* can be absent (Figs. 1G, 17G). The gland *gv2* located on smooth cuticle behind coxa IV can be simple (one gland, one pore, see Fig. 15K) or double (two glands, one pore, see Fig. 7M). Pedipalp: the femur has a small rounded protuberance located next to a broad and slightly pectinate seta *al* (Fig. 1C); on the tibia setae *al1* and *al2* are spatulate.

Legs. Coxae II have on his antero-lateral face, in most of the species, a group of denticles and an extra basal denticle located near a gland pore (Fig. 1L).

TABLE 1. Measurements (in  $\mu\text{m}$ ) and indices characterizing females and males (in parentheses) of new species of the *H. mallorcae* species-group. Abbreviations: Epi. = epigynium; l = length; st = setae on sternal shield.

Species	Locality	Idiosoma-l	Peritremea-l	Tarsus I-l	Tarsus IV-l	Epi.-h	Epi.-b	Epi. b/b	st5-st5'	st1-st1'	st2-st2'	st3-st3'
<i>H. mallorcae</i> J-Bals	Balearic Islands		196-205 (168-190)	154-156 (135-148)	173-178 (150-168)	144-151	168-173	0.86-0.89	91-106	54-56	78-84	96-108
<i>H. ellipticus</i> J-B & Wit.	Italy-Sicily	690-770	(184-190)	164-168 (160-168)	175-183 (173-184)	154-161	168-180	0.89	96-117	55-60	86-96	105-116
<i>H. gibber</i> J-B & Wit.	Spain-Andalusia		204	156-163 (159-169)	173-185 (164-170)	150-160	168	0.92	83-100	54	78-80	102-106
<i>H. mahnerti</i> sp.n.	Morocco		228 (216)	180 (168)	196-198 (180-184)	132	192	0.69	58	58	99	127
<i>H. vaucheri</i> sp.n.	Morocco-Tanger		226 (206)	180 (172-180)	197 (192-197)	132	192	0.69	113	58	99	127
<i>H. variabilis</i> sp.n.	Algeria-Kabylia	648-672 (620-624)	216-220 (197)	168-190 (155-160)	192-216 (175-180)	150-156	168-192	0.8-0.9	100-108	55-60	90-98	110-126
<i>H. franci</i> sp.n	Spain, Morocco	600-730 (590-620)	205-215 (190-204)	161-197 (156-173)	168-209 (170-190)	140-160	156-192	0.85-0.95	48-60	78-98	104-119	
<i>H. canariensis</i> sp.n.	Canary Islands	720-768 (648-672)		184-199 (168-194)	204-297 (197-228)	156-173	204-216	0.77	120-125	60-66	98-102	130-138
<i>H. anaga</i> sp.n.	Spain-Tenerife		264-266 (252-264)	204-206 (204-216)	252-264 (264-276)	187	226-233	0.82	144	60-66	96-98	132-134
<i>H. lapalma</i> sp.n.	Spain-La Palma	864 (720-768)		214 (204-228)	237-257 (228-252)	156-168	240-264	0.64	132-156	55-66	96-98	120-132
<i>H. giganteus</i> sp.n.	Spain-Madeira		264-276 (280)	240-252 (240-247)	264-297 (270)	156-170	264	0.61	151-163	70-74	108-120	144-168
<i>H. lunae</i> sp.n.	Spain-Andalusia		204 (192)	161-168 (138-145)	168-172 (150)	140-144	156-184	0.83	106-113	54	84	102
<i>H. malleus</i> sp.n.	Spain-Andalusia	620-648 (570-575)	180 (190)	160-173 (156-168)	168-180 (165-180)	132-144	144-168	0.9	84-96	53-60	53-60	84-90
<i>H. rifensis</i> sp.n.	Morocco-Rif	648-672 (600-624)	192-197 (190)	156 (151-156)	168 (168-170)	132	163-168	0.78-0.80	96-108	54	84-90	102-118
<i>H. algiensis</i> sp.n.	Algeria-Algiers		175-184 (165-175)	144-150 (140-145)	150-158 (150-154)	161-168	168-173	0.95	96-103	54	84	108-112
<i>H. civisara</i> sp.n.	Spain-Ibiza	(528)	173-192 (146)	144 (132)	156-163 (145)	125-132	156-163	0.8-0.83	90-86	54	78	96
<i>H. singularis</i> sp.n.	Algeria	(528)	163 (134-140)	(132)	(145)							

Male. The sternogenital shield is reticulated. The genital orifice is flanked by triangular presternal platelets and is provided with a subgenital microsclerite bearing a biramous tritosternum; the shape of this microsclerite can be rectangular or trapezoidal large and sclerotized. The genital lamina is located on a more or less pronounced concavity surrounded by lateral protuberances. The species belonging to this group have two types of genital lamina:

1 – the genital lamina is well-sclerotized on its inner face and slightly rounded. The microsclerite bearing the tritosternum is connected to a sclerotized structure, which runs along the internal anterior border of the sternal shield towards the lateral protrusions (in *H. algiersensis* sp. n., *H. variabilis* sp. n., *H. eivissa* sp. n., *H. singularis* sp. n.) (see Fig. 16).

2 – the genital lamina is transparent, with a central prong and more or less developed lateral angles; the microsclerite bearing the tritosternum is rectangular. This type characterizes the other taxa of *H. mallorcae* species-group (see Fig. 4E, F).

The common character of the gnathosoma is the incision of the sclerotized cuticle behind simple or pilose hypostomatic setae; the palpcoxal setae are slightly pilose. The movable digit of the chelicera is provided with an arthrodial membrane bearing paraxially a brush-like process and antiaxially a setiform fringe (Fig. 1A). The brush-like process differs from one species to another.

Armature of leg II: the femoral apophysis and the axillary process are short; the genu and tibia have one apophysis.

Female. The presternal plate is ribbon-like, more or less serrated, and the lateral presternal platelets are free. The sternal shield is reticulated, with an axially granular strip. The heptagonal epigynum is slightly reticulated and has sharp lateral spines which are separated from the central apex by deep concavities. The shape of the endogynium differs from species to species and it is always covered by delicate lamina.

On the gnathosoma the gnathotectum is trispinate; the corniculi are conical. The movable digit of the chelicera has three teeth and the fixed digit has two teeth in front of the pilus dentilis and two larger teeth followed by lamellar margin behind the pilus dentilis (Fig. 11L).

### *Holoparasitus mahnerti* sp. n.

Fig. 1

TYPE MATERIAL: ♂ holotype, 4♂, 3♀ paratypes, MOROCCO, Ibel Mousa by Ceuta, sifting litter under shrubs. 27.03.1963, leg. H.F. (Sp. 882).

DIAGNOSIS: Male. Movable digit of chelicera with 3-4 teeth, fixed digit with 9-10 denticles located subapically; arm of spermatotreme curved ventrally; corniculi with protuberance in distal third; femoral apophysis with small protuberance on its basis. Female. Endogynium sack-like with curtain-like membranous structures.

ETYMOLOGY: This species is dedicated to Prof. V. Mahnert, who kindly helped me to continue my acarological research.

DESCRIPTION: Male. Length of idiosomal setae: on podonotum  $jl = 30 \mu\text{m}$ ,  $r3 = 40 \mu\text{m}$  others around  $30 \mu\text{m}$ ; on opisthonotum 13-15  $\mu\text{m}$ .

Ventral idiosoma. Sternal shield reticulated, without a pattern; genital lamina with bifid central process and rounded margin, located in small concavity (Fig. 1B). Opisthogaster with 8-9 pairs of ventral setae, their length 36  $\mu\text{m}$ . Gland  $gv2$  simple.



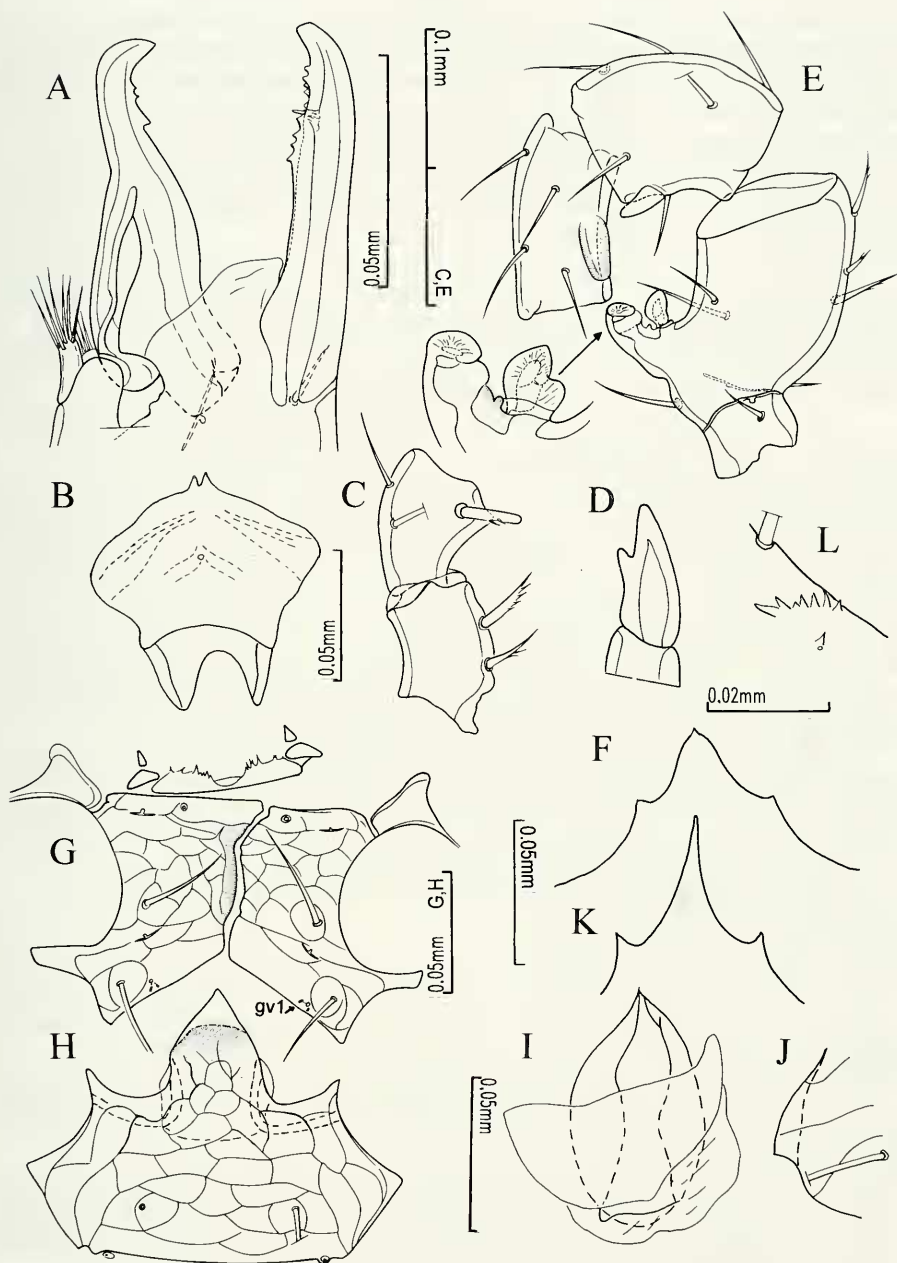


FIG. 1

*Holoparasitus mahnerti* sp. n. male (A-F). (A) Chelicera, paraxial view. (B) Genital lamina. (C) Palptrochanter and palpfemur. (D) Corniculus. (E) Femur, genu, tibia of leg II. (F) Gnathotectum. Female (G-L). (G) Presternal plate and sternal shield. (H) Epigynum. (I) Endogynium. (J) Paragynium, posterolateral protrusion. (K) Gnathotectum. (L) Group of denticles on coxa II.

Gnathosoma. Gnathotectum trispinate, with large and broad median prong carrying a small pointed tip and two smaller lateral prongs (Fig. 1F). Hypognathal groove provided with 10 rows of fine denticles; hypostomatic and palpcoxal setae simple. Corniculi with ventral protuberance in their distal third (Fig. 1D). Palptrochanter with protuberance situated under slightly pilose seta *v1*, seta *v2* barbed (Fig. 1C).

Chelicera (Fig. 1A). Fixed digit straight, its apex truncate, with 9-10 denticles on internal margin. Movable digit with curved apex and 3-4 denticles located subapically; arthrodial membrane with short brush-like process.

Legs. Coxa I with big membranous crenulations; margin of coxa II with group of 5-8 denticles and a basal denticle. Leg II with spurs as follows (Fig. 1E): femoral apophysis thumb-like, axillary process trapezoidal, tiny protuberance between basis of femoral apophysis and basis of axillary process; genu with triangular spur located distally; tibia with oval, sometimes truncated, apophysis.

Female. Length of idiosomal setae: on podonotum *j1*, *r3* = 52  $\mu$ m, *z1* = 13  $\mu$ m, others about 36  $\mu$ m, on opisthonotum setae shorter, about 13-16  $\mu$ m.

Ventral idiosoma. Presternal plate entire, with median constriction and anterior margin serrated; sternal shield reticulated with granular strip medially (Fig. 1G). Length of sternal setae: *st1* = 54-60  $\mu$ m, *st2* = 60-64  $\mu$ m, *st3* = 66  $\mu$ m. Paragynia slightly reticulated, with triangular posterior protrusions (Fig. 1J). Epigynium with sharp lateral spines separated from central apex by concavities; subapical epigynial structure rounded, extending slightly beyond apex margin (Fig. 1H). Endogynium cup-like, with two membranous curtain-like structures on its ventral side, endogynial opening covered with fine lamina (Fig. 1I). Opisthogaster with 8 pairs of ventral setae, their length ranging from 40  $\mu$ m to 52  $\mu$ m. Gland *gv2* double.

Gnathosoma. Gnathotectum trispinate, with long median prong and tiny lateral ones (Fig. 1K). Hypognathal groove with 8-9 denticulated rows, the last two of them simple. Hypostomatic setae simple, palpcoxal setae pilose. Border of palptrochanter thickened between slightly pilose seta *v1* and barbed seta *v2*.

Legs. Coxa I like in male, coxa II with denticulated ridge formed by 5-7 denticles and a basal denticle (Fig. 1L).

### *Holoparasitus mallorcae* Juvara-Bals, 1975

MATERIAL EXAMINED: Mallorca Island. 1 ♀, Palma, field near a dry stream, from a hollow olive tree, 1.IV.1960 (Sp. 700). – 1 ♂, 1 ♀, Palma, spring at the end of a valley, rocks in stream bed, leaf litter, 1.IV.1960 (Sp. 701). – 2 ♂, 2 ♀, Playa Tirant Nou, wet litter composed of sledge and *Tamarix*, 5.IV.1960 (Sp. 713).

Menorca Island. 1 ♂, Menorca, road towards El Marcadal, in valley, wet leaf litter, 3.IV.1960 (Sp. 707). – 6 ♂, 5 ♀, Finca Lavernica near Mahon. spring near road Mahon-Fornells, leaf litter, 4.IV.1960 (Sp. 709).

Ibiza Island. 1 ♂, 2 ♀, Sierra Grosa near San Jose, soil near a spring, altitude 350 m, 9.IV.1960 (Sp. 718). – 6 ♂, 7 ♀, San Miguel, hollow pistachio tree in a small field near a stream, leaf litter and very dry soil, 10. IV. 1960 (Sp. 720). – 4 ♂, 6 ♀, San Miguel near a stream place with rubbish on rocky soil, 10.IV.1960 (Sp. 722). – 7 ♂, 5 ♀, St. Eulalia, from the village towards the interior of the island, hollow tree trunk, wet, altitude 500 m, 11.IV.1960 (Sp. 724a).

Andalusia. 3 ♂, 3 ♀, Barranco de Hermanas, south of Sevilla, *Eucalyptus* leaf litter, 22.II.1951. All specimens collected by H. Franz.

REMARKS: The material examined from different places in the Balearic Islands and from the continent allowed us to show the variability of some morphological characters and compare these specimens with the type material from Mallorca.

The variable characters in females are the shape of the posterior protrusion of the paragnathia and the number of denticles on the lateral walls of the endogynium. These variations are not linked to the localities where the mites were sampled.

Posterior paragnathial protrusions can be rounded or triangular. The type specimen has triangular protrusions but some specimens have one rounded and the other triangular. The lateral endogynium walls are provided with two or four denticles in different combinations (1+1, 1+2, 2+2). The characteristics of males examined seem not to be variable.

*Holoparasitus vaucheri* sp. n.

Fig. 2

TYPE MATERIAL: ♂ holotype, 1♀, 1♂, paratypes; MOROCCO, Gabo Sparte near Tangier, reforestation with *Pinus* and *Thuja*, sifting of litter, 24.03.1964, leg. H.F. (Sp. 961).

ETYMOLOGY: This species is dedicated to Dr. C. Vaucher who kindly provided working space and laboratory facilities.

DIAGNOSIS: Male. Gnathotectum with tongue-like apex provided with sharp angles between its basis and lateral prongs. Chelicera: straight fixed digit its apex slightly curved, carrying 9 denticles on its inner margin; movable digit with 6 denticles and arched arm of spermatotreme. Female. Endogynium cup-shaped, with two short protrusions on posterior margin, epigynum with its subapical structure elliptical.

DESCRIPTION: Male. Dorsal idiosoma. Colour yellowish brown, well-sclerotized. Dimension of idiosomal setae: on podonotum  $j1 = 42 \mu\text{m}$ ,  $r5 = 48 \mu\text{m}$ ,  $j3 = 30 \mu\text{m}$  and others about  $24\text{--}26 \mu\text{m}$ ; opisthonotal setae about  $12\text{--}13 \mu\text{m}$ .

Ventral idiosoma. Genital lamina situated in large concavity of anterior margin of sternal shield; anterior margin of genital lamina with central prong and rounded margin; two well-sclerotized finger-like formations on inner face. Sternogenital shield with scale-like reticulation; length of sternal setae about  $36 \mu\text{m}$ . Gland  $gv2$  double. Length of ventral setae about  $48\text{--}50 \mu\text{m}$ .

Gnathosoma. Gnathotectum with tongue-like central process and two triangular lateral prongs (Fig. 2E). Corniculi elongated, with small prominence located in its proximal part (Fig. 2C). Hypognathal groove with 10 finely denticulate rows. Hypostomatic setae simple, palpcoxal setae pilose. Palptrochanter with setae  $v1$  fine, slightly pilose, whereas  $v2$  thicker and pilose; a small, sharp protuberance situated between these setae (Fig. 2B).

Chelicera (Fig. 2A). Fixed digit straight, with 8 fine denticles. Movable digit with curved apex and 6 small teeth on inner margin, spermatodactyl arched; arthrodial membrane with big brush-like process and antiaxially with fine setiform fringe.

Legs. Coxa II with ridge formed by 10 denticles and an extra basal denticle (Fig. 2G). Spurs on leg II as illustrated in figure 2F: short, rounded femoral apophysis and trapezoidal axillary process; genu with triangular spur located distally; elongated tibial spur situated medially, its mucronate top reaching distal margin of tibia.

Female. Dorsal idiosoma well-sclerotized, brown yellowish coloured. Dimensions of idiosomal dorsal setae:  $j1 = 48 \mu\text{m}$ ,  $z1 = 13 \mu\text{m}$ ; opisthonotal setae tiny, about  $13 \mu\text{m}$ .

Ventral idiosoma. Presternal plate ribbon-like, serrated; sternal shield slightly reticulated with a granular central strip,  $gv1$  located medially near posterior margin (Fig. 2H).

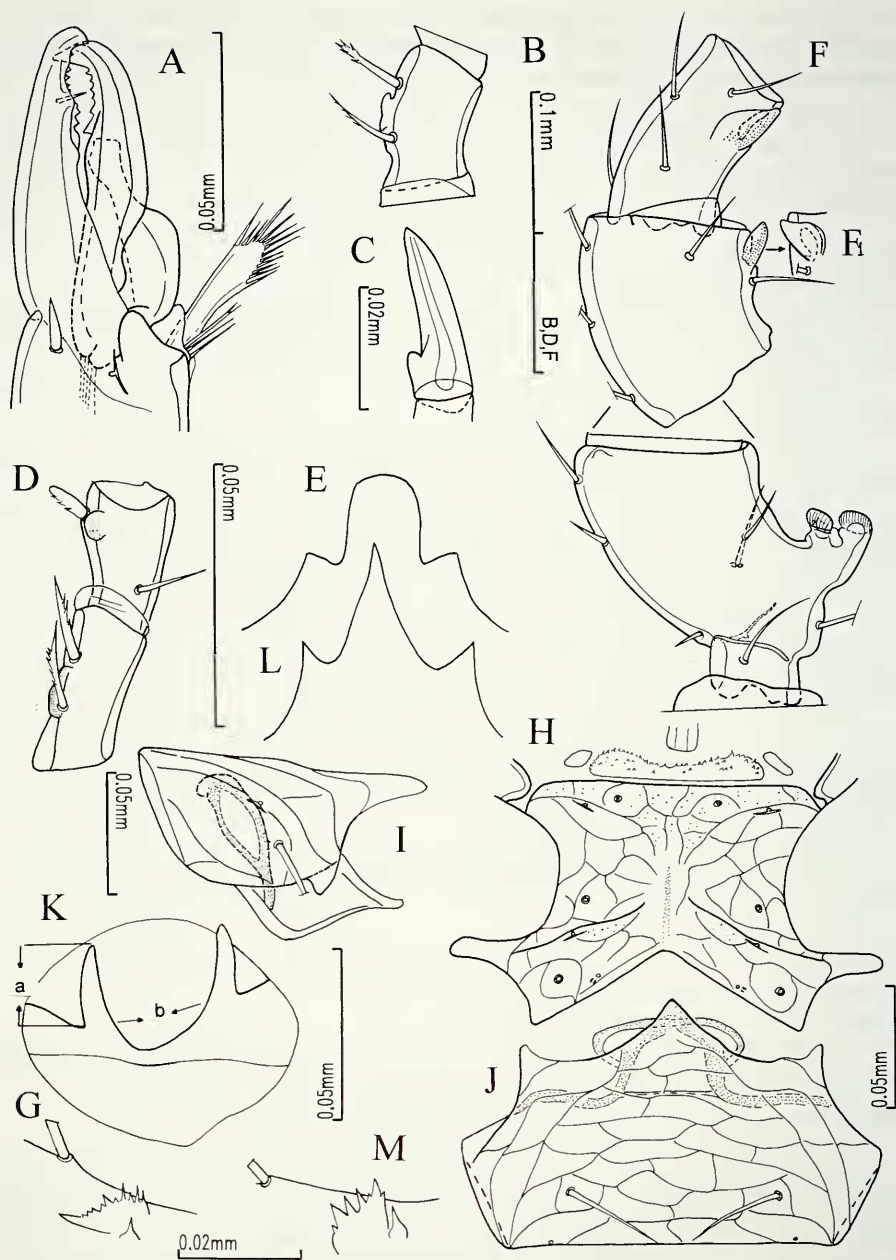


FIG. 2

*Holoparasitus vaucheri* sp. n. male (A-C, E-G). (A) Chelicera, antiaxial view. (B) Palptrochanter. (C) Corniculus. (E) Gnathotectum. (F) Femur, genu, tibia of leg II. F1 tibial apophysis, ventral view. (G) Group of denticles on coxa II. Female (D, H-M). (D) palptrochanter and palpfemur. (H) Presternal plate and sternal shield. (I) Paragynium. (J) Epigynum. (K) Endogynium. (L) Gnathotectum. (M) Group of denticles on coxa II.



Paragynial shield with triangular, posterolateral protrusion; metagynial sclerite ellipsoidal (Fig. 2I). Anterior margin of epigynium with a large triangular apex; subapical epigynial structure formed by a sclerotized rectangle and ellipsoidal hyaline wings (Fig. 2J). Endogynium a large cup with two short, conical protrusions on its posterior margin, covered by a delicate membrane (Fig. 2K). Gland gv2 double.

Gnathosoma. Gnathotectum trispinate, its central prong sharply pointed (Fig. 2L). Corniculi conical; hypognathal groove with 9 oligodenticulated rows of denticles. Palpcoxal seta and hypostomatic setae slightly pilose, hypostomatic seta 3 simple. Palptrochanter with a flattened protuberance between setae *v1* and *v2*, both setae pilose (Fig. 2D).

Legs. Coxa II with a comb-like structure with 8 denticles and an extra basal denticle (Fig. 2M).

### *Holoparasitus franzi* sp. n.

Fig. 3

TYPE MATERIAL: ♂ holotype, 68♂, 144♀ paratypes; MOROCCO, southwest of Taza, col Bab-Azhar, National Park "Jbel Tazzeke, cedar wood (*Cedrus atlantica* Manetti), 1770 m, sifting leaf litter 16.06.1990, leg. B. Hauser.

#### OTHER MATERIAL EXAMINED

FRANCE. 1♀; between Argelès and Collioure, sifting of leaf litter of cork oak, 22.03.1959, leg. H.F. (Sp. 628).

SPAIN. 1♀; Montes de Malaga, road from Malaga to Puento del Leon, turf and litter, 28.03.1959 (Sp. 642). – 2♀, Sierra Nevada, close to the road to the Albergo, 1600 m, near a little stream, moss and litter under bushes, 10.04.1959 (Sp. 679). – 1♂, Cantoria Almeria, soil from inside a hollow olive tree, 22.03.1964 (Sp. 957). – 2♀, 2♂, Sierra de la Filares (Almeria) near tunnel on the road Cantoria-Uleila, humid litter under *Ulex*, 22. 04.1964 (Sp. 958a). All the material was collected by H. Franz.

MOROCCO, Middle Atlas. 1♀, 1♂, road from Ifrane to Boulemane, leaf litter from cedar and oak (*Quercus petraea*), 30.03.1963 (Sp. 893). – 3♀, 1♂, Ifrane, leaf litter from cedar and oak, 30.03.1963 (Sp. 894). – 5♀, 3♂, Jbel Tazzeke, cedar forest on north slope, sifting of leaf litter, 1950 m, 1.04.1963 (Sp. 897). – 2♀, Tanout Pass between Khenifra and Midelt, litter under oak, 2070 m, 2.04.1963 (Sp. 900).

MOROCCO, Upper Atlas. 2♀, 2♂, 2dn, "Cirque" of Jaffar near Midelt, litter under oak, 3.04.1963 (Sp. 902). – 3♀, 3♂, Toufliat near Marrakech, soil and leaf litter under cork oak, 6.04.1963 (Sp. 912). – 1♀, 2♂, Oukaïmeden near Marrakech, moss under bushes, 2100 m, 12.04.1963 (Sp. 925). – 3♀, 3♂, Valley under Oukaïmeden, leaf litter from maquis near little stream, 12.04.1963 (Sp. 926). – 1♀, Bin el-Ouidane towards Afourer, maquis litter in gully, 17.04.1963 (Sp. 934). – 2♀, 3♂, idem, slope towards Afourer, litter in humid gully, 17.04.1963 (Sp. 935). – 2♀, 2♂, Middle Atlas, near Bin el-Ouidane, maquis leaf litter, 27.03.1964 (Sp. 967). All the material was collected by H. Franz.

MOROCCO, Middle Atlas. 3♀, 8♂, 1dn, Bab-Azhar, Tazzeke region, 1330 m, soil under cork oak, 1.06.1978. – 12♂, 15♀, between Ifrane and Azrou, 1600 m, soil under oak, 4.06.1978. – 6♂, 4♀, Taza, road from Col Bab-Taka to Bab-Azhar, National Park "Jbel Tazzeke", 1940 m, sifting of soil and leaf litter under a fallen cedar tree, 16.06.1990. – 6♂, 20♀, Sefrou to Boulame, 41 km before Sefrou near Tizi-Abekhnanus Pass, 1700 m, green oak forest, soil under trees, 22.06.1990. – 8♂, 8♀, road Ifrane-Mischliffen, south Ifrane, 1930 m, cedar wood mixed with green oak and maple tree, before the ski station, soil sampled under cedar (*Cedrus atlantica*), 23.06.1990. – 5♂, 3♀, Azrou-Midelt road junction 1 km before "Cèdre Gourauld", 1770 m, soil under cedar, 23.06.1990. All the material was collected by B. Hauser.

ETYMOLOGY: This species is named in honour of Prof. H. Franz whose conscientious collecting of arthropods has helped so much to increase our knowledge of the soil fauna.

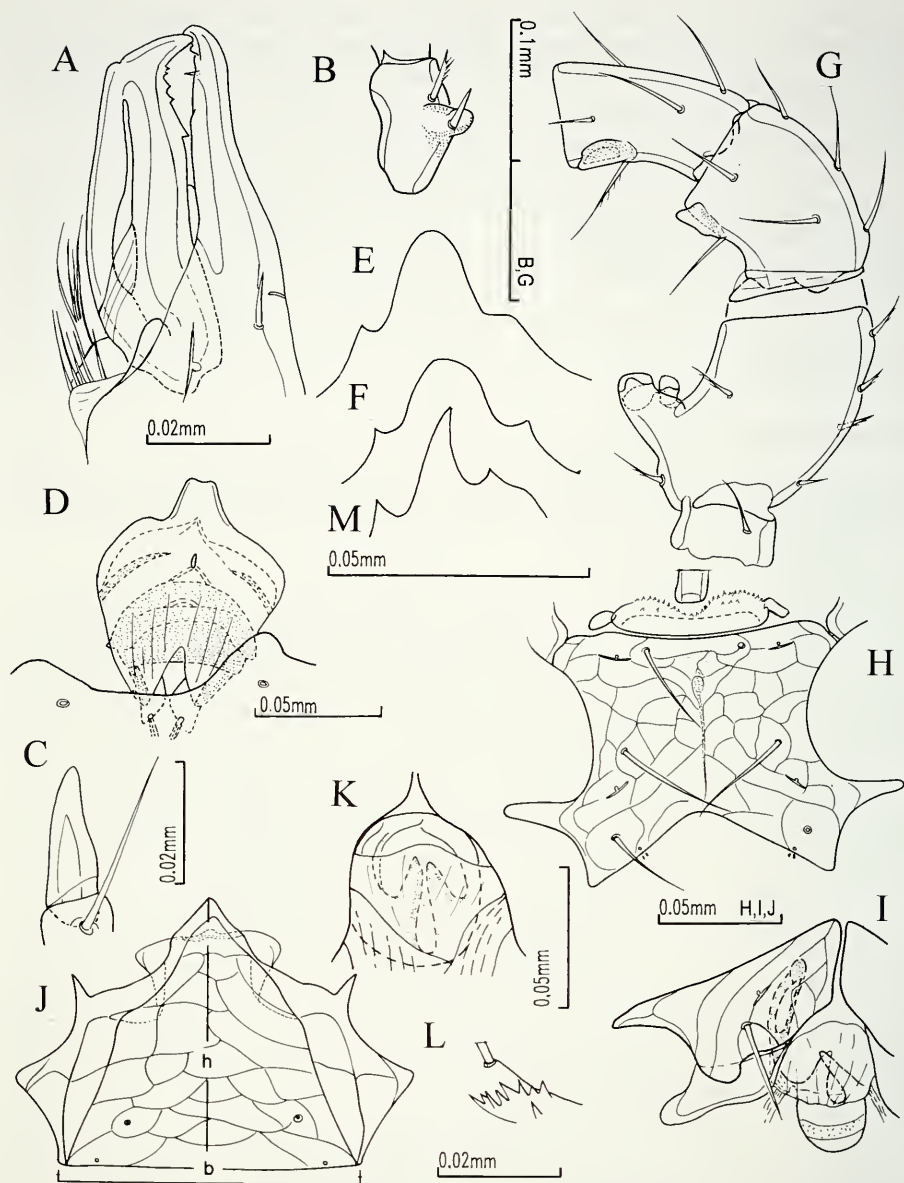


FIG. 3

*Holoparasitus franzi* sp. n. male (A-G, L). (A) Chelicera, antiaxial view. (B) Palptrochanter. (C) Corniculus. (D) Genital lamina. (E, F) Gnathotectum. (G) Femur, genu, tibia of leg II. (L) Group of denticles on coxa II. Female (H-K, M). (H) Presternal plate and sternal shield. (I) Paragynium and endogynium. (J) Epigynum. (K) Endogynium. (M) Gnathotectum.

**DIAGNOSIS:** Male. Gnathotectum with anterior margin of apex rounded, small concavities between its basis and lateral prongs; chelicera with straight fixed digit carrying one tooth between slightly curved apex and pilus dentilis; movable digit bearing 5 denticles on its inner margin and a specific prominence on external side at end of spermatotreme; palptrochanter with short seta *v1* inserted on big protuberance and with barbed seta *v2*. Female. Endogynium, cup-like, with 2 short triangular protrusions.

**DESCRIPTION:** Male. Dorsal idiosoma. Well-sclerotized, yellowish brown in colour. Length of podonotal setae: *j1* = 36  $\mu$ m, *r5* = 42  $\mu$ m, *s6* = 30  $\mu$ m, others from 24 to 36  $\mu$ m. Opisthonotal setae from 18  $\mu$ m to 12  $\mu$ m.

Ventral idiosoma. Sternal shield reticulated, without a particular pattern; length of sternal setae about 42  $\mu$ m. Genital lamina with large central process and rounded angles; rectangular microsclerite with rounded anterior corners (Fig. 3D). Length of ventral setae 30-36  $\mu$ m. Simple gland *gv2*.

Gnathosoma. Gnathotectum with rounded apex and two little lateral prongs; central part of gnathotectum granular (Fig. 3E-F). Hypostome with hypognathal groove provided with 9-11 rows of fine denticles; hypostomatic and palpcoxal setae slightly pilose, hypostomatic seta 3 simple. Corniculi conical, slightly swollen paraxially (Fig. 3C). Palptrochanter with thick, simple seta *v1* inserted on big protuberance and with barbed seta *v2* (Fig. 3B).

Chelicera (Fig. 3A). Fixed digit slender, its apex slightly curved; 1-2 little teeth between pilus dentilis and apex. Movable digit with 5 teeth on its inner margin and large curved apex with a specific rounded prominence on external side at end of spermatotreme; small brush-like process on base of movable digit.

Legs. Coxa II with comb-like structure formed by 8 denticles and extra basal denticle (Fig. 3L). Armature of leg II (Fig. 3G): femur with short thumb-like apophysis and short rounded axillary spur; genu with triangular apophysis extending slightly beyond distal margin; triangular tibial apophysis situated medially on anterolateral face.

Measurements. Specimens from the Upper Atlas (Sp. 902) are bigger than the others: tarsus I = 168-173  $\mu$ m, tarsus IV = 192-197  $\mu$ m.

Female. Idiosoma well-sclerotized, yellowish brown. Length of podonotal setae: *j1* = 36-42  $\mu$ m, *r5* = 42  $\mu$ m, *z1* = 16-17  $\mu$ m, other setae about 36  $\mu$ m; setae shorter on opisthonotum, 20-18  $\mu$ m.

Ventral idiosoma. Presternal plate ribbon-like, densely denticulated; sternal shield reticulated; length of sternal setae: *st1*, *st2* = 54-60  $\mu$ m; *st3* = 65-70  $\mu$ m; gland pore *gv1* located below setae *st3* (Fig. 3H). Paragynia weakly reticulated, triangular posterolateral protrusions; metagynial sclerite with its paraxial margins straight (Fig. 3I). Epigynium with anterior margin formed by a large triangular apex and two spine-like lateral prongs; subapical epigynial structure with hyaline wing-like protrusions extending laterally and with a subapical sclerotized line (Fig. 3J). Endogynium cup-shaped, covered by a fine membrane; posterior margin with two short triangular protrusions, their tips reaching anterior margin of endogynium (Fig. 3K). Length of ventral setae: *ZV1* = 48  $\mu$ m, others about 36  $\mu$ m. Gland *gv2* double.

Gnathosoma. Gnathotectum trispinate, with long median prong and two tiny lateral tips (Fig. 3M). Hypognathal groove with 9-11 rows of denticles, the last four oligodent. Hypostomatic setae and palpcoxal seta slightly pilose. Palptrochanter with flat protuberance between slightly pilose seta *v1* and barbed seta *v2*.

Legs. Coxa II with a comb-like ridge formed by 8-9 denticles, sometimes also with basal one.

***Holoparasitus variabilis* sp. n.**

Fig. 4

TYPE MATERIAL: ♂ holotype, 5♂, 3♀ paratypes, ALGERIA, Djurdjura-Kabylia, road Tala Guilé, 1100 m, sifting of leaf litter and moss, oak wood, 8.05.1988.

OTHER MATERIAL EXAMINED: 4♂, 9♀, 2 dn, Djurdjura Tikijada-Kabylia, 1430 m, sifting of soil and litter near cedar trunks, 8.05.1988. All material was collected by C. Besuchet and I. Löbl.

ETYMOLOGY: The species name *variabilis* refers to the different shapes of the female endogynial protrusions.

DIAGNOSIS: Male. Chelicera with straight and narrow fixed digit, its apex slightly curved, 5-8 denticles on inner margin; movable digit with 3-6 denticles, arm of spermatotreme arched. Female: epigynium with triangular apex, subapical structure small and rounded; endogynium cup-like, posterior margin with two protrusions close each to another and in some specimens unequal in size.

DESCRIPTION: Male. Dorsal idiosoma. Colour reddish brown. Dimensions of podonotal setae: *j1* = 36 µm, others from 24 µm to 30 µm. Opisthonotal setae from 12 µm to 18 µm.

Ventral idiosoma. Sternogenital shield reticulated. Genital lamina located in a shallow concavity; its anterior margin undulating, with a rectangular median process (Fig. 4F). Subgenital microsclerite large, rectangular and well-sclerotized (Fig. 4E). Length of ventral setae from 36 to 24 µm. Gland *gv2* double.

Gnathosoma. Gnathotectum trispinate (Fig. 4D). Corniculi conical, with small prominence medially (Fig. 4G). Hypognathal groove with 9 rows of small denticles, simple hypostomatic setae, pilose palpcoxal setae. Palptrochanter with *v1* pilose and *v2* barbed (Fig. 4C).

Chelicera (Fig. 4B). Narrow fixed digit with slightly curved apex, internal anti-axial margin provided with 6-8 small denticles. Movable digit bearing 3-6 denticles, ventral arm of spermatotreme arched; arthrodiol membrane with small brush-like process.

Legs. Coxa II provided with a ridge of 10-11 denticles and a tiny basal denticle (Fig. 4H). Armature of leg II characterized by small, rounded femoral apophysis and axillary process; an elongated apophysis located on anterior margin of genual segment; tibial apophysis rectangular (Fig. 4A).

Female. Dorsal idiosoma. Length of setae: podonotum *j1* = 37 µm, other setae of row *j* = 40-42 µm, *s1* = 12 µm; on opisthonotum small setae, their length 14-18 µm.

Ventral idiosoma. Presternal plate serrated and sternal shield reticulated with small granular strip medially, gland pore *gv1* located near posterior margin in vicinity of seta *st3* (Fig. 4I). Paragynial shield reticulated with oval posterior protrusions; metagynial sclerite elliptical (Fig. 4J). Epigynium with sharply, triangular apex and



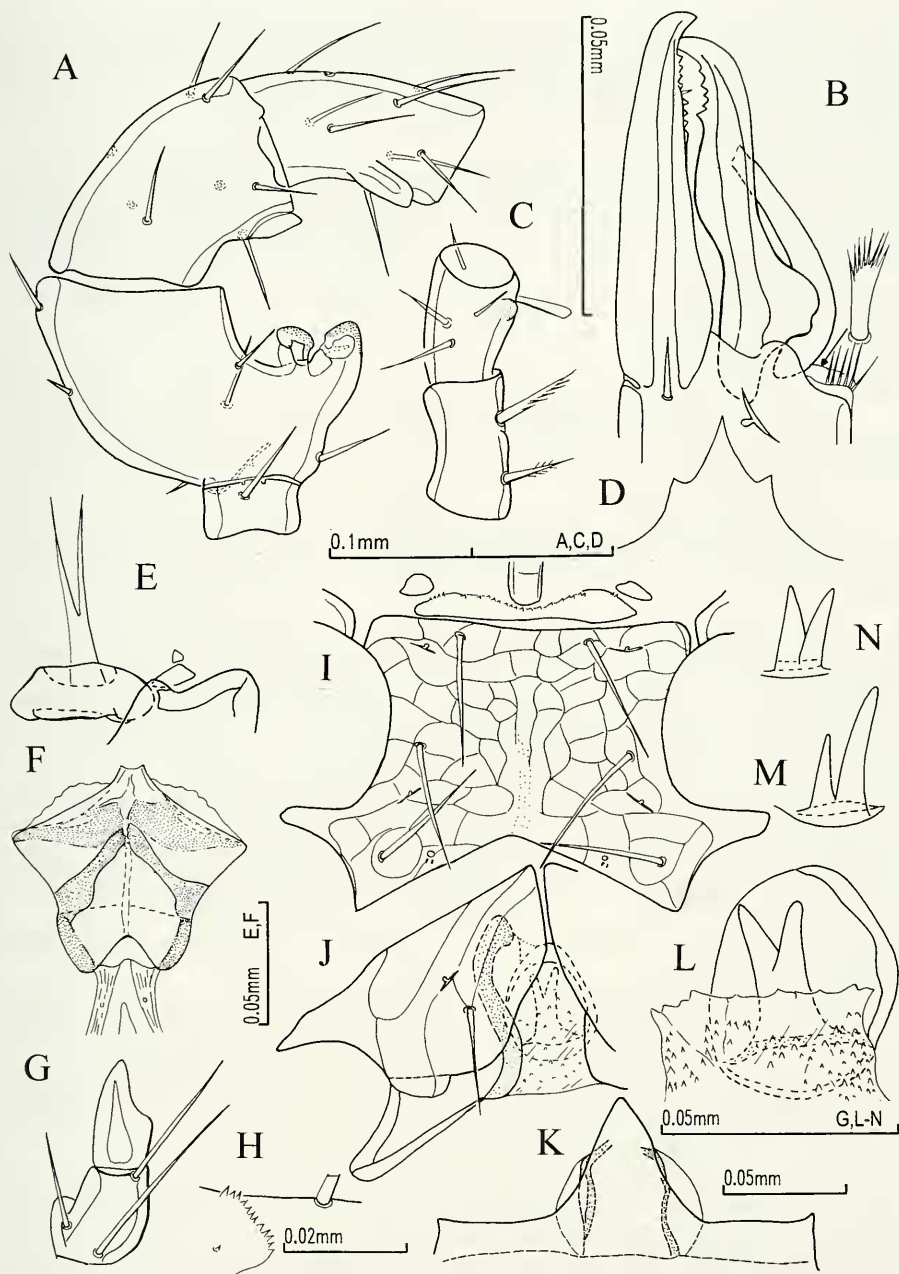


FIG. 4

*Holoparasitus variabilis* sp. n. male (A-G). (A) Femur, genu, tibia of leg II. (B) Chelicera, antiaxial view. (C) Palptrochanter and palpfemur. (D) Gnathotectum. (E) Microscлерite and tritosternum. (F) Genital lamina. (G) Corniculus. (H) Group of denticles on coxa II. Female (I-N). (I) Presternal plate and sternal shield. (J) Paragynium and endogynium. (K) Apex of paragynium. (L) Endogynium. (M, N) Endogynial protrusions.

faintly sclerotized, rounded subapical structure (Fig. 4K). Endogynium cup-shaped, posterior margin with two protrusions of various shapes: finger like and equal to each other, one short and other long, or bifid, close to each other or even fused (Fig. 4L-N). Opening of endogynium covered by fine scaled lamina. Length of ventral setae 36-40  $\mu\text{m}$ . Gland *gv2* double.

Gnathosoma. Gnathotectum trispinate, with one long central prong and two tiny laterals. Hypognathal groove with 11 rows of denticles, the last 4 with 2 denticles. Hypognathal setae simple and palpcoxal setae pilose. Palptrochanter with pilose seta *v1* and barbed seta *v2*.

Legs. Characteristics of legs inconspicuous. Anterolateral ridge of coxa II as in males.

***Holoparasitus canariensis* sp. n.**

Figs 5, 6A-E

TYPE MATERIAL: ♂ holotype, 9♂, 9♀ paratypes, SPAIN, Canary Islands, Gran Canaria, El Brezal, sifting of litter and rotten wood, laurel forest "Laurisilvia", 25.03.1967, leg H.F. (Sp. 1129).

OTHER MATERIAL EXAMINED:

Gran Canaria. 4♂, 4♀, El Brezal, sifting of leaf litter in laurel forest, 4.08.1966, leg H.F. (Sp. 1079). – 1♂, 1♀, El Brezal, sifting of leaf litter, laurel forest, 11.08.1966, leg. H.F. (Sp. 1095). – 2♂, Barranco de Fingas, sifting of leaf litter near a waterfall, 10.08.1966, leg. H.F. (Sp. 1092).

La Gomera. 2♂, 4♀, El Campamento, sifting of leaf litter, laurel forest, 22.04.1965, leg. H.F. (Sp. 1064-1065). – 2♂, 1♀, Monte de Valle, Hermosa, laurel forest, 21.04.1965, leg H.F. (Sp. 1060). – 2♀, El Campamento, laurel forest, 22.04.1965 leg. H.F. (Sp. 1064). – 2♂, 12♀, "Parque Nacional Garajonay", road towards Alajero, under the summit of Garajonay, 1320 m, forest with *Pinus* sp. and *Erica* sp., soil, 3.05.1993, leg. B.H.

El Hierro. 14♂, 16♀, above Frontera, side of the road to Valverde, laurel forest, "Laurisilva", soil near an old laurel, 1130m, 5.05.1993, leg. B.H.

Tenerife. 2♂, 1♀, north Erjos (Teno district), leaf litter under *Erica arborea* and *Laurus* sp., 4.04.1965, leg. H.F. (Sp. 1027). – 3♂, 2♀, north Erjos, leaf litter under *Castanea* tree, 4.04.1965, leg. H.F. (Sp. 1028). – 1♀ Monte de Erjos (Teno district), rotten wood and litter, 13.08.1972, leg. H.F. (Sp. 1273). – 5♂, 6♀, 2dn, "Parque Nacional del Teide" (Las Canadas) under the cable car station, 2280 m, soil under *Spartocytisus supranubius*, 8.05.1993, leg. B.H.

ETYMOLOGY: The species name refers to the Canary Islands where the species seems to be common.

DIAGNOSIS: Male. Movable digit of chelicera with curved apex and 6 denticles on inner margin; straight and long fixed digit with 8 denticles; gnathotectum produced into a pyramidal process with rounded apex. Female. Cup-shaped endogynium with two prolongations (*a* = 24-30  $\mu\text{m}$ ) separated by a distance of 40-45  $\mu\text{m}$ ; subapical structure of epigynium elliptical.

DESCRIPTION: Male. Dorsal idiosoma. Colour reddish brown. Podonotal setae simple, their length: *j1* = 36-38  $\mu\text{m}$ . *z1* = 12  $\mu\text{m}$ , others from 36 to 42 (*r3*)  $\mu\text{m}$ . Opisthonotal setae shorter, around 12-15  $\mu\text{m}$ .

Ventral idiosoma. Genital lamina with large central trapezoidal process and with rounded angles; microsclerite rectangular (Fig. 5A). Sternal shield reticulated; length of sternal setae 30 to 42  $\mu\text{m}$ ; *gv1* located medially. Length of ventral setae about 24-25  $\mu\text{m}$ . Variability of gland *gv2*: simple (Gran Canaria) or double (Gomera, El Hierro).

Gnathosoma. Gnathotectum a pyramidal process, its apex rounded; some specimens with two tiny spines located lateral to apex (Fig. 5D-F). Hypognathal

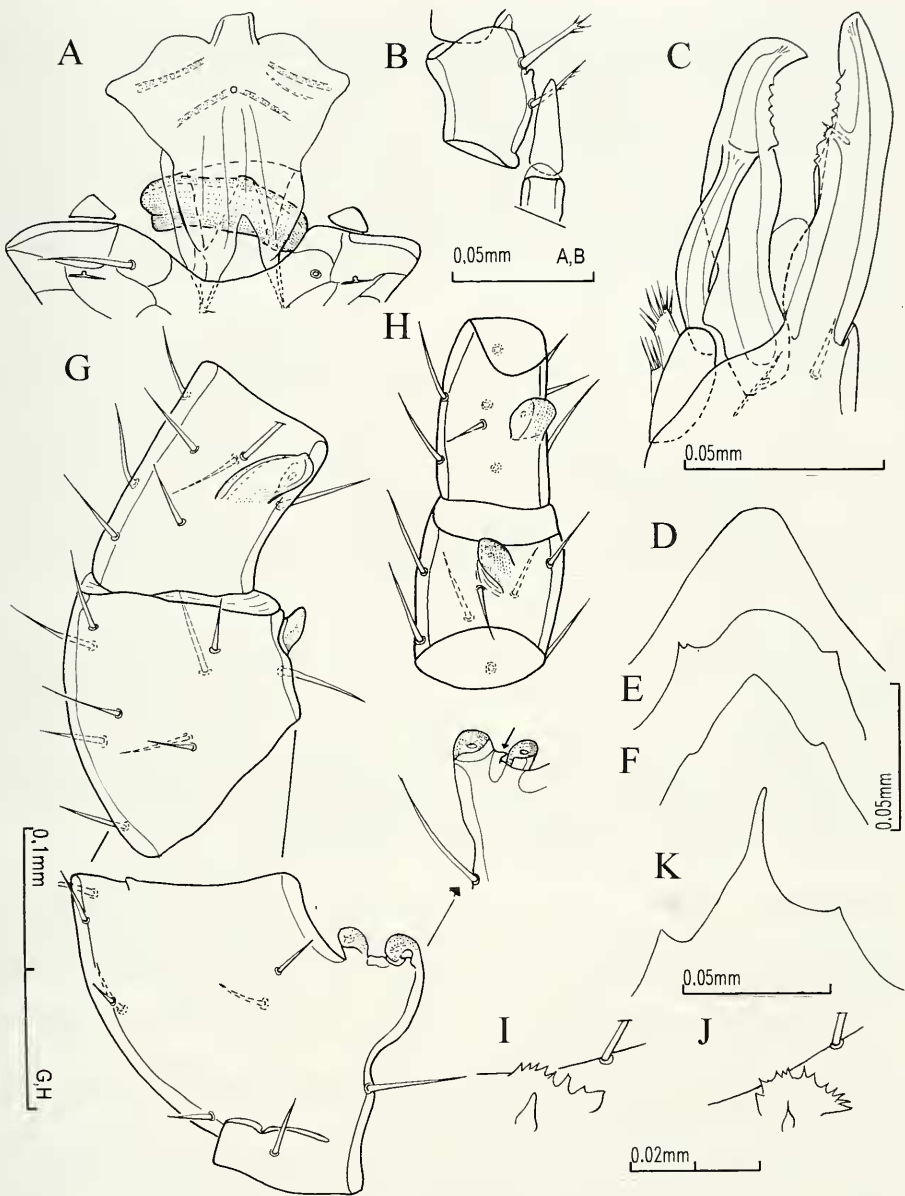


FIG. 5

*Holoparasitus canariensis* sp. n. male (A-I). (A) Genital lamina and microsclerite. (B) Palptrochanter and corniculus. (C) Chelicera, paraxial. (D, E, F) Gnathotectum. (G) Femur, genu, tibia of leg II, anterolateral view. (H) Genu, tibia, ventral view. (I) Group of denticles on coxa II. Female (J, K). (J) Group of denticles on coxa II. (K) Gnathotectum.

groove with 8 rows of very fine denticles. Hypostomatic setae simple, palpcoxal setae pilose. Corniculi slender and conical (Fig. 5B). Palptrochanter with slightly thickened ridge between pilose seat  $v1$  and pectinate seta  $v2$  (Fig. 5B).

Chelicera (Fig. 5C). Fixed digit straight, its apex truncate; internal margin with 7-9 denticles located paraxially and a sinuous margin antiaxially; pilus dentilis situated between these edges. Movable digit hooked, with 6 denticles on inner margin; arthrodial membrane with short brush-like process.

Legs. Coxa II with ridge bearing from 6 to 11 denticles and an extra basal denticle; one specimen with 10 denticles on left and 5 on right coxa (Fig. 5I). Leg II bearing spurs as follows (Fig. 5G, H): rounded femoral apophysis and trapezoidal axillary process, both their apices at same level; short, triangular genual spur located near distal margin of the segment; triangular tibial apophysis or sometimes with a bud-like apex.

Female. Dorsal idiosoma. Colour brownish yellow. Setae on podonotal region from  $48\text{ }\mu\text{m}$  (*jI*) to  $12\text{ }\mu\text{m}$  (*zI*), others around  $24\text{ }\mu\text{m}$ ; length of opisthonotal setae  $12\text{--}18\text{ }\mu\text{m}$ .

Ventral idiosoma. Presternal plate serrated, sternal shield reticulated, with granular strip medially; length of sternal setae around  $70\text{ }\mu\text{m}$ , gland pore *gvI* located medially on posterior sternal margin (Fig. 6A). Paragynial shields slightly reticulated, with small rounded posterior protrusions; metagynial sclerite elongated (Fig. 6B). Epigynium with triangular apex; subapical epigynial structure with a sclerotized strip continued by elliptical membranous wings (Fig. 6C-E).

Endogynium cup-shaped, with two digitiform protrusions ( $24\text{--}30\text{ }\mu\text{m}$ ) on its posterior margin; distance between their bases  $40\text{--}45\text{ }\mu\text{m}$ ; a fine hyaline flap covering endogynium on ventral side (Fig. 6D-E). Length of ventral setae  $36\text{ }\mu\text{m}$ . Gland *gv2* simple or double.

Gnathosoma. Gnathotectum trispinate, with long median spine (Fig. 5K). Hypognathal groove with 7-8 oligodent rows; palpcoxal seta pilose, hypostomatic setae simple. Palptrochanter with simple seta *vI* and pilose *v2*.

Legs. Coxa II with a fan-like ridge as in males (Fig. 5J).

### *Holoparasitus anaga* sp. n.

Figs 6 F-K, 7

TYPE MATERIAL: ♂ holotype, 5 ♂, 4 ♀ paratypes; SPAIN, Canary Islands, Tenerife, Anaga Mountains, on the road towards Pico del Inglés, sifting of leaf litter in a laurel forest, 8.04.1965, leg H.F. (Sp. 1038).

OTHER MATERIAL EXAMINED: 1 ♂, 1 ♀, northern slope of Pico del Inglés, leaf litter in a laurel forest, 13.04.1965, leg. H.F. (Sp. 1406).

ETYMOLOGY: The species name, a noun in apposition, refers to Mount Anaga where the specimens were sampled.

DIAGNOSIS: Both sexes with ventral protuberance on trochanter IV. Males with straight and very large fixed digit of chelicera and trapezoidal gnathotectum. Females with simple triangular gnathotectum; endogynium with two small, 36 to  $48\text{ }\mu\text{m}$  long protrusions on posterior margin, distance between their bases  $48\text{ }\mu\text{m}$ .

DESCRIPTION: Male. Dorsal idiosoma. Length of idiosomal setae: *jI* =  $48\text{ }\mu\text{m}$ , *zI* =  $18\text{ }\mu\text{m}$ , *r3-r5* =  $42\text{--}48\text{ }\mu\text{m}$ , others on podonotum  $24\text{ }\mu\text{m}$ . Opisthonotal setae short  $12\text{--}15\text{ }\mu\text{m}$ .

Ventral idiosoma. Genital lamina with rounded angles and trapezoidal central prong (Fig. 7H). Sternogenital shield reticulated with marked line under setae *st2*;



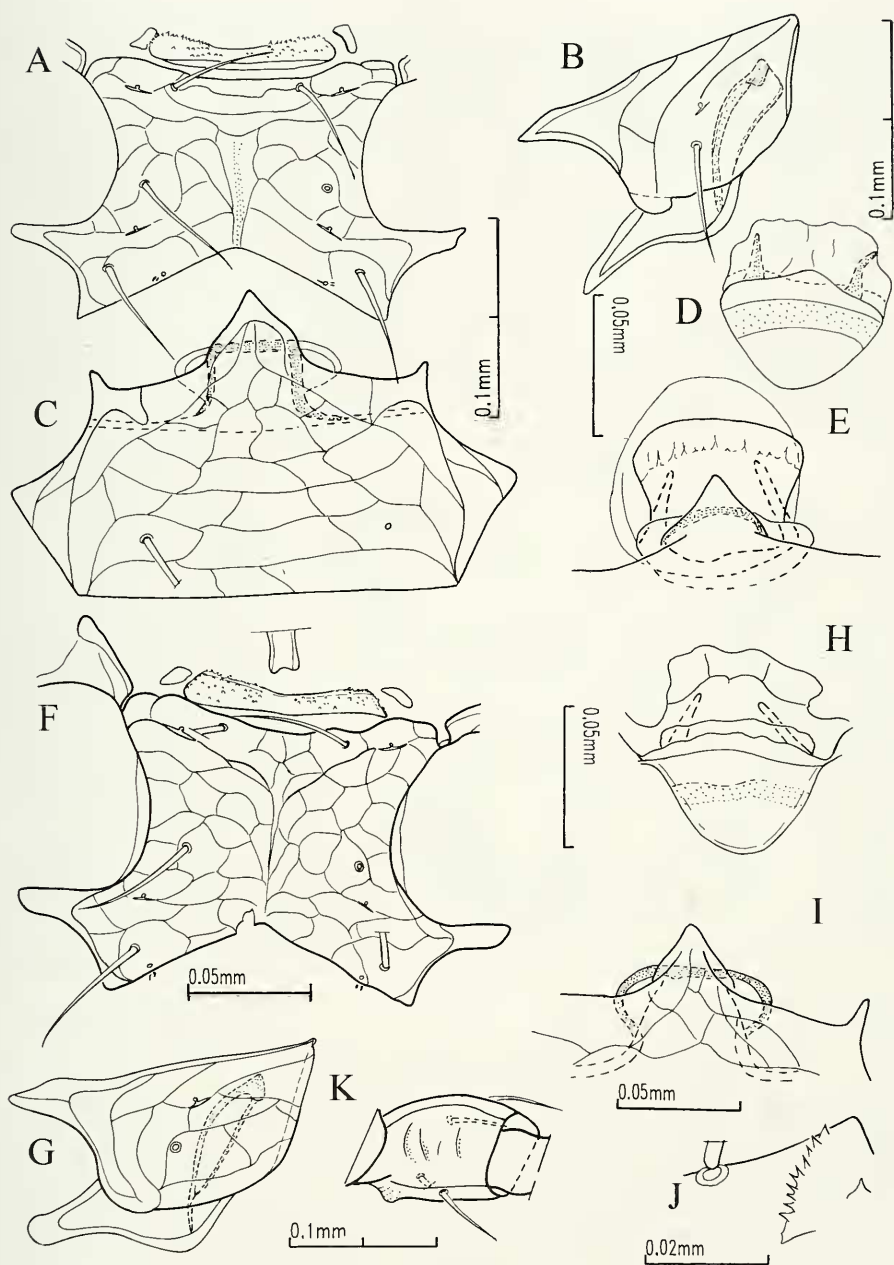


FIG. 6

*Holoparasitus canariensis* sp. n. female (A-E). (A) Presternal plate and sternal shield. (B) Paragynium. (C) Epigynum. (D) Endogynium. (E) Apex of epigynum and endogynium. *Holoparasitus anaga* sp. n., female (F-K). (F) Presternal plate and sternal shield. (G) Paragynium. (H) Endogynium. (I) Apex of epigynum. (J) Group of denticles on coxa II. (K) Trochanter IV.

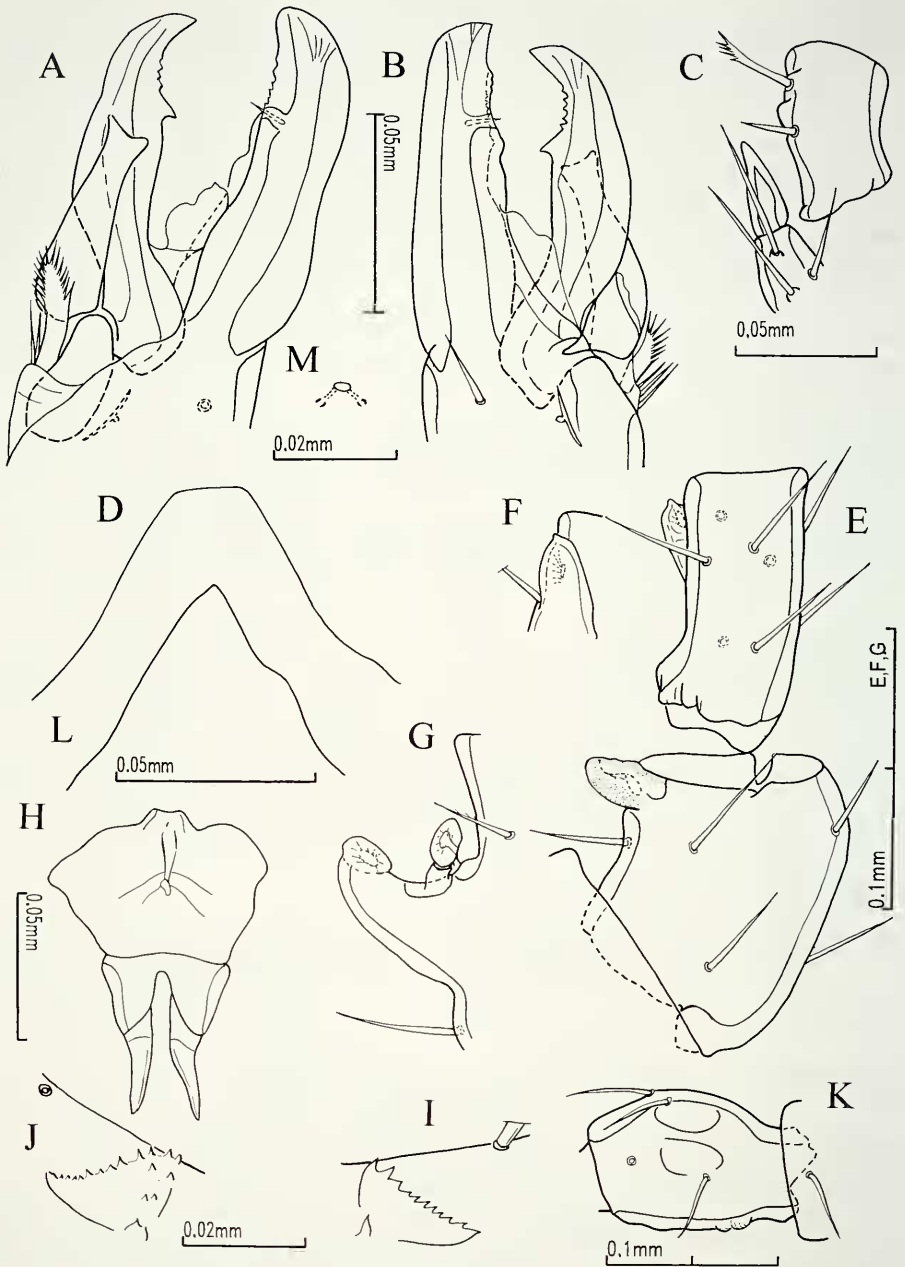


FIG. 7

*Holoparasitus anaga* sp. n. male (A-K). (A) Chelicera, paraxial view. (B) Chelicera, antiaxial view. (C) Palptrochanter and corniculus. (D) Gnathotectum. Leg II. (E) Genu and tibia. (F) Tibial apophysis, ventral view. (G) Femoral apophysis and axillary process. (H) Genital lamina. (I, J) Group of denticles on coxa II. (K) Trochanter IV. Female (L-M). (L) Gnathotectum. (M) Double gland gv2.

length of sternal setae:  $st1 = 60 \mu\text{m}$ ,  $st2-st3 = 54 \mu\text{m}$ . Length of ventral setae around  $36 \mu\text{m}$ ,  $ZV1 = 42 \mu\text{m}$ . Gland  $gv2$  with one gland, some specimens with two glands.

Gnathosoma. Trapezoidal gnathotectum, some specimens with slightly concave apex (Fig. 7D). Hypognathal groove with 7-8 rows of fine denticles, hypostomatic setae simple, palpcoxal seta finely pilose. Corniculi triangular. Palptrochanter with protuberance between simple seta  $v1$  and pilose seta  $v2$  (Fig. 7C).

Chelicera (Fig. 7A-B): fixed digit very large, with 5-6 denticles around pilus dentilis; movable digit slightly hooked with 4-5 denticles and a tooth on inner margin; arthrodial membrane with medium-size brush-like process.

Legs. Coxa II with ridge bearing 11 denticles and a basal denticle, one specimen with ridge of 14 denticles and 5 basal denticles (Fig. 7I-J). Armature of leg II as in figures 7 E-G: curved femoral apophysis, oval axillary process, both ending on same level; elongated genual apophysis protrude beyond distal margin of the segment; large triangular tibial apophysis carrying a small tip on its apex. Trochanter IV with protuberance located ventrally (Fig. 7K).

Female. Dorsal idiosoma. Colour brownish yellow; length of podonotal setae:  $jl = 54 \mu\text{m}$ ,  $zl = 18 \mu\text{m}$ ,  $r3 = 36 \mu\text{m}$ ,  $r5 = 60 \mu\text{m}$ ; opisthonotal setae shorter 15-18  $\mu\text{m}$ .

Ventral idiosoma. Presternal plate ribbon-like, serrated, some specimens with few denticles; sternal shield reticulated, with two marked lines forming a "V" under setae  $st1$ , length of sternal setae from 66 to 72  $\mu\text{m}$ ; gland pore  $gv1$  usually located on posterior margin of sternal shield, in some specimens on cuticle (Fig. 6F). Paragnathia reticulated, with rounded posterior protrusion not very prominent; metagnathia elliptical (Fig. 6G). Epigynium with large triangular apex, subapical epigynial structure ellipsoidal, with sclerotized anterior border (Fig. 6I). Endogynium cup-like, two small protrusions located on posterior margin and covered by hyaline flap (Fig. 6H). Length of ventral setae from 36  $\mu\text{m}$  to 50  $\mu\text{m}$ . Gland  $gv2$  double

Gnathosoma. Gnathotectum triangular, lateral tips obliterated (Fig. 7L). Hypognathal groove with 9 rows of fine denticles. Hypostomatic setae simple. Palptrochanter bumpy between pilose setae  $v1$  and barbed setae  $v2$ .

Legs. Coxa II with ridge of 12 denticles and a basal denticle (Fig. 6J). Trochanter IV with protuberance situated ventrally (Fig. 6K).

### *Holoparasitus lapalma* sp. n.

Figs 8-9

TYPE MATERIAL: ♂ holotype, 1 ♀ paratype; SPAIN, Canary Islands, La Palma, Los Tilos, leaf litter in a gorge near Cascada de Los Tilos, 14.08.1966 leg. H.F. (Sp. 1100).

OTHER MATERIAL EXAMINED: 2 ♂, 1 ♀, La Palma, Cascada de Los Tilos near Sauces, leaf litter in a gorge, 17.04.1965, leg. H.F. (Sp. 1051-1052). – 3 ♂, 2 ♀, La Palma, Parrador des Los Tilos, leaf litter, 17.04.1965 leg. H.F. (Sp. 1053). – 1 ♂, 1 ♀, La Palma, Fuente de la Zarza, moss near a spring, 17.08.1966, leg. H.F. (Sp. 1109). – 1 ♂, 1 ♀, La Palma, Barranco Franceses, sifting of *Laurus* leaf litter, 17.08.1966 leg. H.F. (Sp. 1110). – 1 ♂, idem, 27.03.1970. – 1 ♂, La Palma, Roque del Faro, rotten bark of *Pinus canariensis*, 27.03.1970 leg. H.F. (Sp. 1235). – 1 ♂, 1 ♀, La Palma, Road between Santa Cruz and El Paso, 15 km away from Santa Cruz, anterior leaf litter and soil in laurel forest, 880m, 10.05.1993, leg. B. H.

ETYMOLOGY: The species name, a noun in apposition, is derived from La Palma Island where the specimens were found.

DIAGNOSIS: Male. Gnathotectum tongue-like; chelicera with straight fixed digit with inner margin denticulate near pilus dentilis and with movable digit bearing 6-8

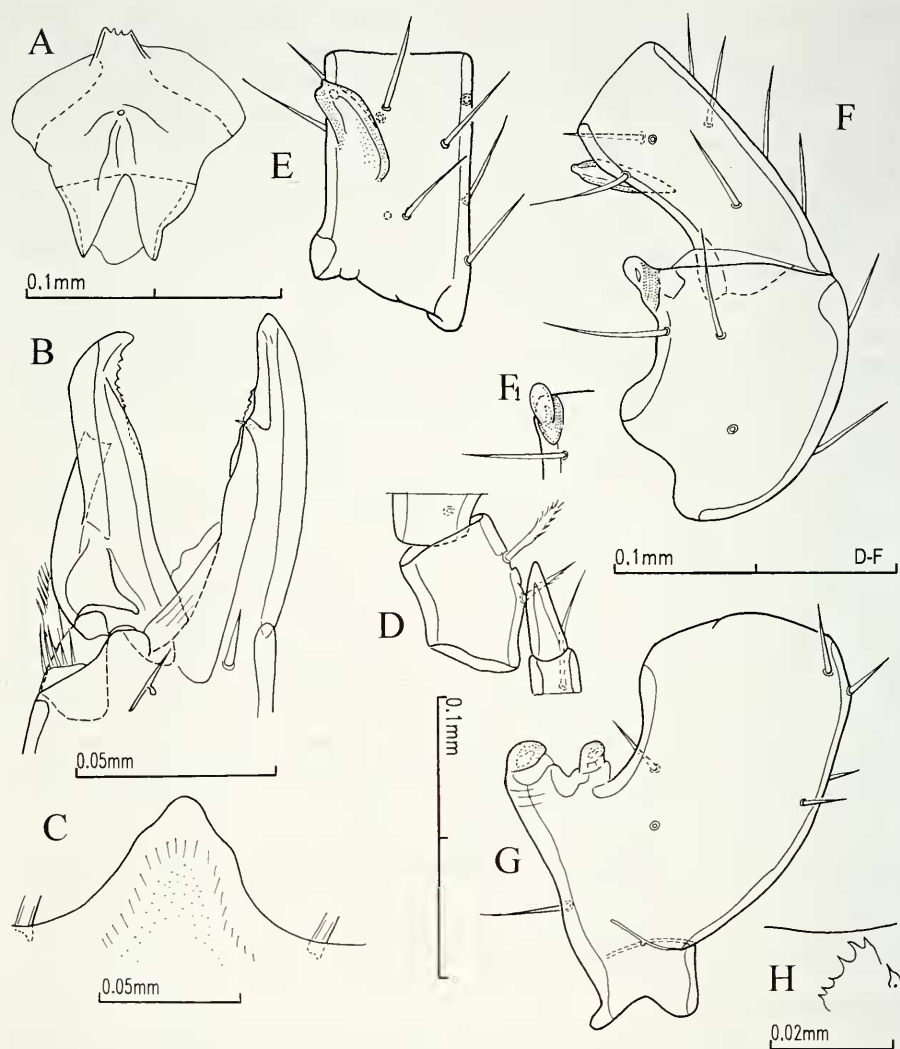


FIG. 8

*Holoparasitus lapalma* sp. n. male. (A) Genital lamina. (B) Chelicera, antiaxial. (C) Gnathotectum. (D) Palptrochanter and corniculus. Leg II. (E) Tibia, ventral view. (F) Genu, tibia posterolateral view, F1genu, apophysis, ventral view. (G) Femur, posterolateral view. (H) Group of denticles on coxa II.

denticles. Female: presternal plates without or with few denticles; epigynum with sharp triangular apex and trapezoidal subapical structure surrounded by membranous lateral wings; endogynum sack-like, with vestigial protrusions.

DESCRIPTION: Male. Dorsal idiosoma. Colour brownish red; length of podonotal seate:  $j1 = 36 \mu\text{m}$ ,  $z1 = 18 \mu\text{m}$ , others from 24 to  $30 \mu\text{m}$ ; seate on opisthonotum  $18 \mu\text{m}$ .



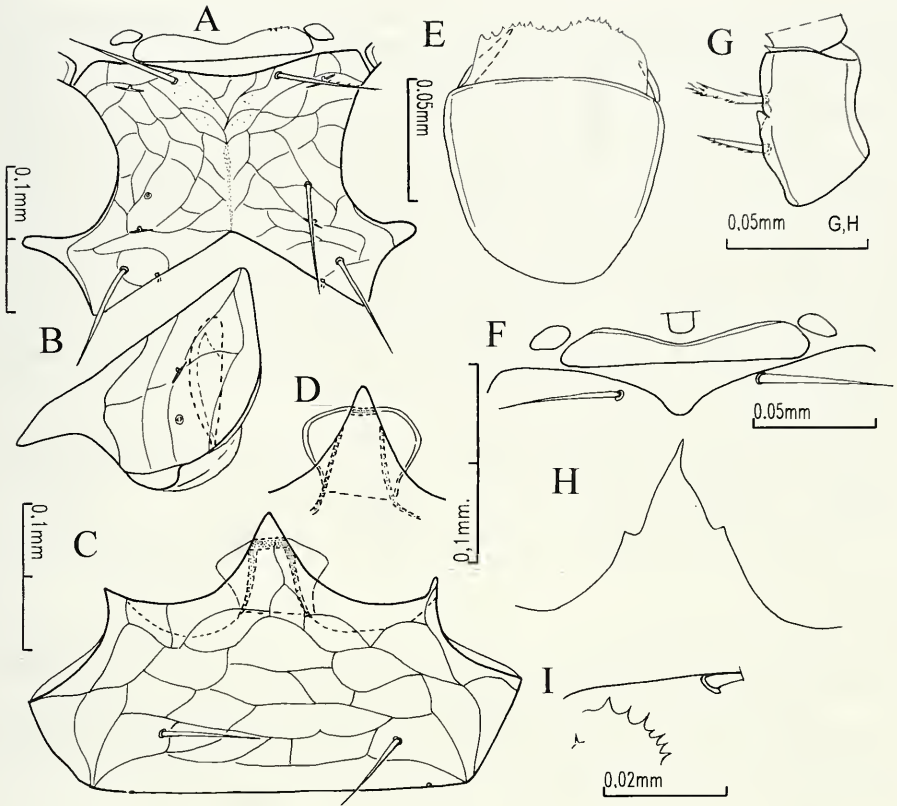


FIG. 9

*Holoparasitus lapalma* sp. n. female. (A) Presternal plate and sternal shield. (B) Paragynium. (C) Epigynum. (D) Apex of epigynum. (E) Endogynium. (F) Presternal plate. (G) Palptrochanter. (H) Gnathotectum. (I) Group of denticles on coxa II.

Ventral idiosoma. Genital lamina with trapezoidal process and rounded lateral corners; rectangular microsclerite located behind genital lamina (Fig. 8A). Sternogenital shield with a polygonal reticulation and a distinct line near setae *st2*; length of sternal setae: *st1*, *st2* = 60  $\mu\text{m}$ , *st3* = 54  $\mu\text{m}$ . Length of ventral setae 25-30  $\mu\text{m}$ . Gland *gv2* double.

Gnathosoma. Gnathotectum tongue-like (Fig. 8C). Corniculi triangular. Hypognathal groove with 9-10 rows of denticles; hypostomatic setae simple, palpcoxal setae pilose. Palptrochanter with pilose seta *v1* and barbed seta *v2*, between them a small protuberance (Fig. 8D).

Chelicera (Fig. 8B): straight fixed digit with truncate apex and 5-6 tiny denticles around pilus dentilis; movable digit with 7-8 denticles on inner margin and with medium-sized brush-like process.

Legs. Coxa II with ridge bearing 6 denticles and a basal denticle (Fig. 8H). Armature of leg II as in figures 8E-G: short, rounded femoral apophysis and axillary

process; finger-like and protruded apophysis situated on distal margin of genual segment; tibia with large triangular mucronate apophysis.

Female. Dorsal idiosoma. Podonotal setae:  $j1 = 36 \mu\text{m}$ ,  $z1 = 15-18 \mu\text{m}$ ,  $r3 = 42 \mu\text{m}$ , others about  $24 \mu\text{m}$ . Opistonotal setae around  $12-18 \mu\text{m}$ .

Ventral idiosoma. Presternal plate ribbon-like, generally simple, some specimens with few denticles; sternal shield reticulated, with granular strip medially, position of gland pore  $gv1$  variable, either medially, on posterior margin, or in some specimens on cuticle. (Fig. 9A, F). Length of sternal setae:  $st1 = 66 \mu\text{m}$ ,  $st2 = 60 \mu\text{m}$ ,  $st3 = 70 \mu\text{m}$ . Paragynial shield reticulated, with rounded posterior paragynial protrusion; metagynial sclerite elliptical (Fig. 9B). Epigynium with sharp triangular apex, trapezoidal subapical structure surrounded by membranous fan-like wings (Fig. 9C-D). Endogynium sack-like with two vestigial protrusions located on posterior margin, covered by delicate, serrated lamina (Fig. 9E). Length of ventral setae from  $30 \mu\text{m}$  to  $36 \mu\text{m}$ . Gland  $gv2$  double.

Gnathosoma. Gnathotectum trispinate (Fig. 9H). Hypognathal groove with 10 rows of fine denticles; hypostomatic setae and palpcoxal setae pilose. Palptrochanter with thickened boarder between pilose seta  $v1$  and barbed seta  $v2$ .

Legs. Coxa II with anterolateral ridge bearing 7-9 denticles plus a basal denticle (Fig. 9I).

***Holoparasitus giganteus* sp. n.**

Fig. 10

TYPE MATERIAL: ♂ holotype, 1 ♀ paratype, SPAIN, Madeira, Ribeiro Grande and Ribeiro Bonito, leaf litter, laurel forest, 7.04.1967, leg. H.F. (Sp. 1148-1151).

OTHER MATERIAL EXAMINED: 2 ♀, Queimadas near Santana, leaf litter in laurel forest, 1.04.1967, leg. H.F. (Sp. 1141). – 1 ♀, Acha das Areias, under Boca de Encumeada, leaf litter in laurel forest, 5.04.1967, leg. H.F. (Sp. 1146).

ETYMOLOGY: The species name alludes to the size of this mite.

DIAGNOSIS: Big species, ♂ tarsus I =  $242-247 \mu\text{m}$ , tarsus IV =  $270 \mu\text{m}$ ; ♀ tarsus I =  $240-252 \mu\text{m}$ , tarsus IV =  $265-300 \mu\text{m}$ . Male. Sternogenital shield reticulated, with granular cuticle; gnathotectum triangular, with rounded apex; chelicera with straight fixed digit bearing 9 denticles around pilus dentilis and movable digit with 5 denticles and a tooth. Female. Presternal shield ribbon-like, platelets free; endogynium cup-like, with two protrusions, their height  $48 \mu\text{m}$  and basal distance between them  $55 \mu\text{m}$ ; epigynium large, subapical structure with two triangular wings.

DESCRIPTION. Only some of the main characters could be observed because the specimens examined were squashed.

Male. Dorsal idiosoma. Colour reddish brown. Most setae lost during the preparation; length of setae on opisthonotum from  $14$  to  $18 \mu\text{m}$ .

Ventral idiosoma. Sternogenital shield reticulated, with granular cuticle. Genital lamina with anterior margin undulating, with rectangular apex and rounded lateral angles (Fig. 10D). Microsclerite rectangular and mucronate.

Gnathosoma. Gnathotectum triangular, with rounded apex (Fig. 10B). Corniculi conical; palptrochanter with simple seta  $v1$  and pilose  $v2$  (Fig. 10A). Chelicera (Fig. 10C): straight fixed digit with 9 denticles around pilus dentilis; movable digit with 5 denticles and a tooth, arm of spermatotreme straight. Arthrodial membrane with small brush-like process.

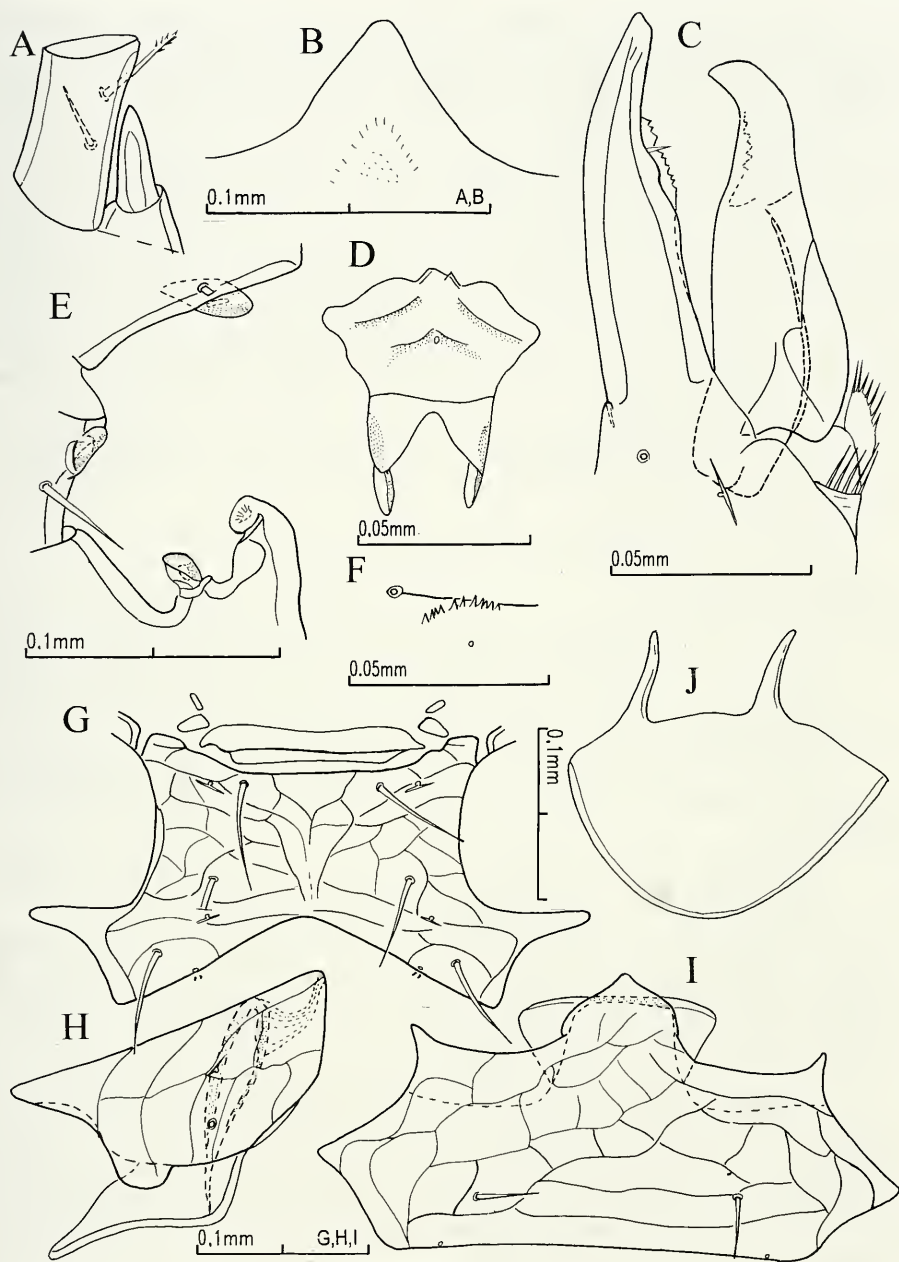


FIG.10

*Holoparasitus giganteus* sp. n. male (A-F). (A) Palptrochanter and corniculus. (B) Gnathotectum. (C) Chelicera, antiaxial view. (D) Genital lamina. (E) Femur, genu, tibia of leg II. (F) Group of denticles on coxa II. Female (G-J). (G) Presternal plate and sternal shield. (H) Paragynium. (I) Epigynum. (J) Endogynium.

Leg II. Coxa with an anterolateral ridge of 11 denticles (Fig. 10F). Armature of leg II illustrated in figure 10E: short and thumb-like femoral apophysis and short rectangular axillary process located distally to main femoral spur; on genu an elongated spur near distal margin of segment; rectangular tibial apophysis with rounded apex.

Female. Dorsal idiosoma. Colour reddish brown. On podonotum seta *jl* = 48  $\mu\text{m}$ , others from 24 to 36  $\mu\text{m}$ ; length of setae on opisthonotum around 18  $\mu\text{m}$ .

Ventral idiosoma. Presternal plate without denticles; sternal shield reticulated, length of sternal setae 54 to 60  $\mu\text{m}$ , *gv1* located in distal quarter of posterior margin (Fig. 10G). Paragynia with rounded posterior protrusion and elliptical metagynial sclerite (Fig. 10H). Epigynium large, apex triangular, mucronate, subapical structure extended into two triangular wings (Fig. 10I). Endogynium cup-like, with two protrusions on posterior margin, their height 48  $\mu\text{m}$ , distance between them 55  $\mu\text{m}$  (Fig. 10J). Gland *gv2* simple.

Gnathosoma. Gnathotectum triangular with rounded apex and vestiges of lateral prongs. Hypostomatic and palpcoxal setae pilose. Palptrochanter with simple seta *v1* and pilose seta *v2*.

Legs. Coxa II with ridge of 8 denticles, basal denticle absent.

### *Holoparasitus lunae* sp. n.

Fig. 11

TYPE MATERIAL: ♂ holotype, 2♂, 3♀ paratypes; SPAIN, Ceiro de Mirador, Sierra de Luna, near Algeciras, Andalusia; sifting of leaf litter and humus, 28.02.1951, leg. H.F. (Sp. 41).

ETYMOLOGY: The species name refers to the Sierra de Luna where the specimens were found and is also a dedication to my grand-daughter Luna.

DIAGNOSIS: Male. Gnathotectum with straight lateral angles and tongue-like central apex. Female: endogynium cup-like, with one finger-like protrusion on posterior margin.

DESCRIPTION: Male. Dorsal idiosoma. Length of setae: on podonotal region from 24  $\mu\text{m}$  to 18  $\mu\text{m}$ , *jl* 30  $\mu\text{m}$ ; on opisthonotal region about 13  $\mu\text{m}$ .

Ventral idiosoma. Sternogenital shield slightly reticulated, length of sternal setae *st1* = 40  $\mu\text{m}$ , *st3* = 33  $\mu\text{m}$ . Genital lamina located in small concavity of sternogenital margin. Genital lamina with rounded angles and an indented median process (Fig. 11E); microsclerite large and trapezoidal. Opisthogaster with 8 pairs of ventral setae, their length about 26-30  $\mu\text{m}$ . Gland *gv2* double.

Gnathosoma. Gnathotectum with anterior margin having lateral teeth and rounded, prominent central prong. Hypognathal groove provided with 9 rows of very fine denticles, simple hypostomatic setae located on small protuberance, palpcoxal setae simple. Corniculi triangular, with sharp, small protuberance in their inner, proximal third (Fig. 11C). Palptrochanter with slightly pilose seta *v1* located on rounded prominence and pilose seta *v2* (Fig. 11D).

Chelicera (Fig. 11A). Fixed digit slender, with slightly truncated apex protruding above movable digit; inner margin of fixed digit with 4-6 teeth. Movable digit curved, its inner margin provided with 5-6 denticles and a large median tooth; spermatotreme reaching level of proximal tooth; arthrodial cuticle with a small brush-like process.



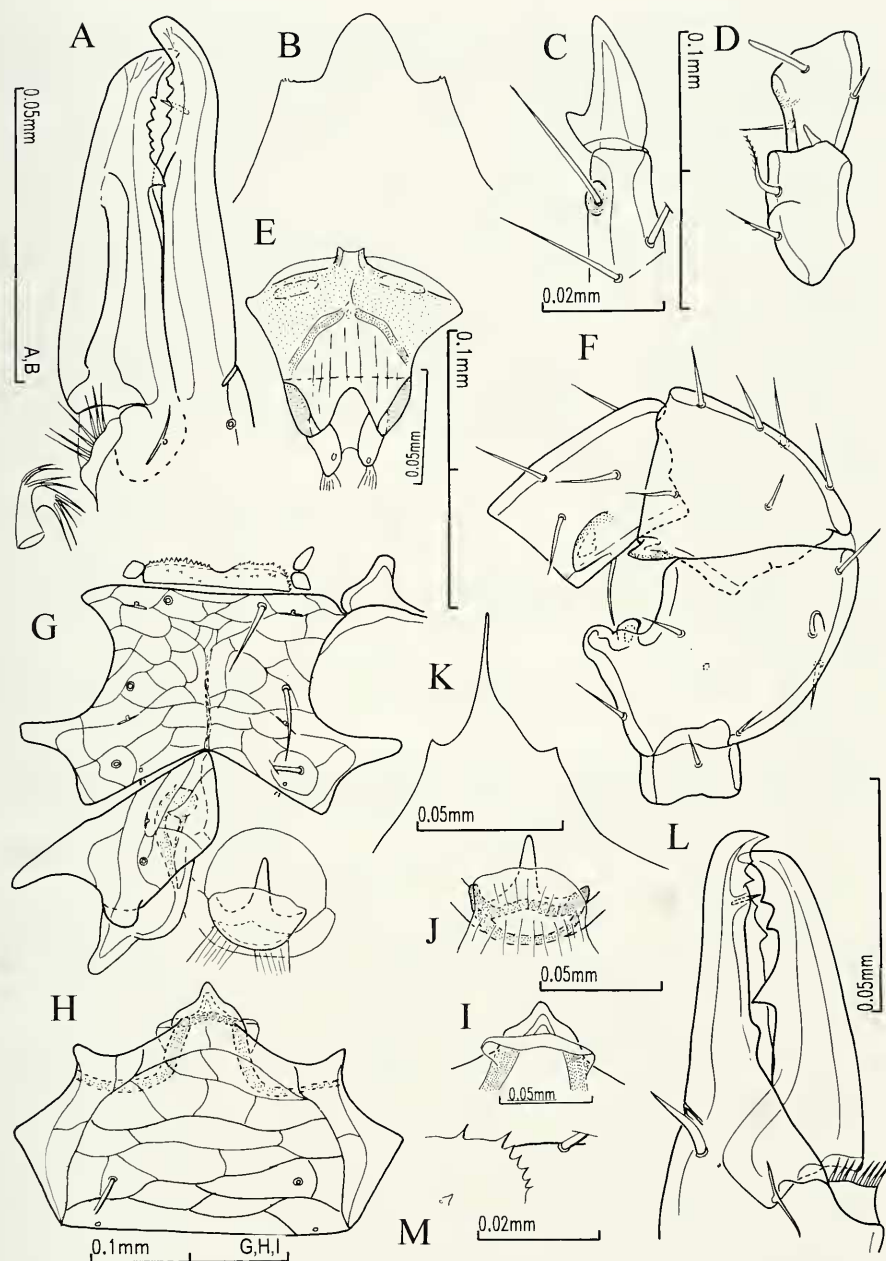


FIG. 11

*Holoparasitus lunae* sp. n. male (A-F). (A) Chelicera, antiaxial view. (B) Gnathotectum. (C) Corniculus. (D) Palptrochanter and palpfemur. (E) Genital lamina. (F) Femur, genu, tibia of leg II. Female (G-M). (G) Presternal plate, sternal shield, paragynium and endogynium. (H) Epigynum. (I) Apex of epigynum, dorsal view. (J) Endogynium. (K) Gnathotectum.

Legs. Coxa II with rounded comb-like structure formed by 6 denticles and a basal extra one. Armature of leg II (Fig. 11F): short, thumb-like femoral apophysis and trapezoidal axillary process; triangular spur located near distal margin of genual segment; large triangular tibial apophysis situated medially.

Female. Dorsal idiosoma. Length of setae: on podonotum from 24 to 36  $\mu\text{m}$ , on opisthonotum shorter around 12  $\mu\text{m}$ .

Ventral idiosoma. Presternal plate entire, ribbon-like, serrated; sternal shield reticulated with a longitudinal strip medially, length of sternal setae 36-40  $\mu\text{m}$ ; gland pore *gv1* located in vicinity of seta *sr3* (Fig. 11G). Paragynial shield reticulated, with rounded posterolateral protrusions; arched metagynial sclerite (Fig. 11G). Epigynial shield with anterior margin formed by a broad triangular apex and two lateral, not very prominent prongs; subapical epigynial structure with a strong sclerotized rectangle and two hyaline wing-like protrusions (Fig. 11H-I). Endogynium a cup with one central finger-like protrusion located on an elliptical sclerotized structure and covered by a hyaline membrane (Fig. 11G, J).

Opisthogastric region with 8-9 pairs of ventral setae, their length about 26  $\mu\text{m}$ . Gland *gv2* double.

Gnathosoma. Gnathotectum trispinate with long central prong and two tiny lateral spines (Fig. 11K). Hypognathal groove with 10 weakly denticulated rows. Simple hypostomatic and pilose palpcoxal setae. Palptrochanter with simple seta *v1* and pilose *v2*.

Legs. Coxa II with a group of 7-8 denticles and a tiny basal denticle (Fig. 11M).

### *Holoparasitus malleus* sp. n.

Fig. 12

TYPE MATERIAL: 1♂ holotype, 2♂, 9♀ paratypes, SPAIN, Malaga Mountains, Venta Galvey, sifting leaf litter under bushes, 20.04.1963, leg. H.F. (Sp. 942).

ETYMOLOGY: The species name (Latin: *malleus* = hammer), a noun in apposition, refers to the form of the fixed digit of the male chelicera.

DIAGNOSIS: Male. Gnathotectum with large, protuberant and rounded apex and a sharp angle between its base and lateral prongs, corniculi with small protuberance medially, chelicera with hammer-like fixed digit. Female: endogynium with one slender protrusion, located on posterior margin, apex of protrusion sharp or bifid.

DESCRIPTION: Male. Dorsal idiosoma. Well-sclerotized, light brown in colour. Length of podonotal setae: *jl* = 32  $\mu\text{m}$ , other setae of *r* row 26  $\mu\text{m}$  to 30  $\mu\text{m}$ . Opisthonotal setae very short 10 to 12  $\mu\text{m}$ .

Ventral idiosoma. Sternal shield reticulated, genital lamina situated in a shallow concavity. Anterior margin of genital lamina with a trapezoidal prong and rounded lateral margins (Fig. 12F). Microsclerite trapezoidal (Fig. 12E). Opisthogaster with 8 pairs of ventral setae, their length: *JV3*, *JV5* = 24  $\mu\text{m}$ , *ZV1* = 30  $\mu\text{m}$ . Gland *gv2* simple.

Gnathosoma. Gnathotectum with triangular lateral prongs forming a sharp angle with basis of protuberant and rounded central prong (Fig. 12B). Hypognathal groove with 9 slightly denticulated rows. Simple hypostomatic and pilose palpcoxal setae. Corniculi with small prominence situated medially on ventral face (Fig. 12D). Palptrochanter with short seta *v1* located on protuberance and pilose seta *v2* (Fig. 12C).

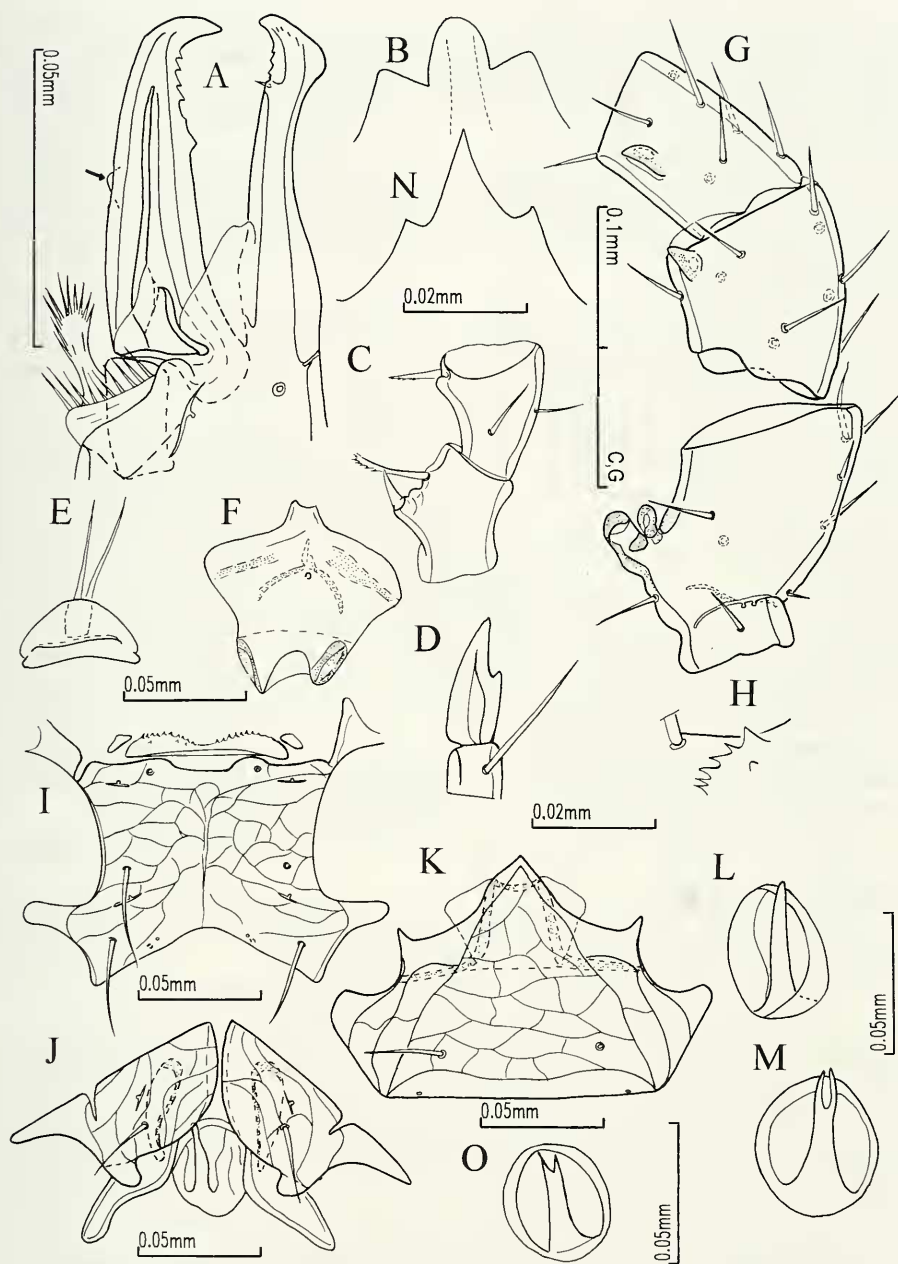


FIG.12

*Holoparasitus malleus* sp. n. male (A-H). (A) chelicera, antiaxial view. (B) Gnathotectum. (C) Palptrochanter and palpfemur. (D) Corniculus. (E) Microsclerite and tritosternum. (F) Genital lamina. (G) Femur, genu, tibia of leg II. (H) Group of denticles on coxa II. Female (I-N). (I) Presternal plate and sternal shield. (J) Paragnathium and endognathium. (K) Epigynum. (L, M, O) Endognathium. (N) Gnathotectum.

Chelicera (Fig. 12A). Fixed digit hammer-like, with 6 denticles on its inner margin between pilus dentilis and apex. Movable digit with hooked apex and 4-5 denticles on its inner margin; long spermatotreme ending at level of third denticle on movable digit, its arm with small protuberance medially; arthrodial membrane with long brush-like process.

Legs. Coxa II with rounded ridge of 8 denticles and an extra basal denticle (Fig. 12H). Spurs on leg II as in figure 12G. Short femoral apophysis and oval axillary process ending on same level; genu with conical spur located distally; tibia with a short trapezoidal spur.

Female. Dorsal idiosoma. Cuticle reddish-brown coloured. Length of podonotal seate:  $j1 = 32\mu\text{m}$ ,  $j2$  and  $j6 = 32\mu\text{m}$ ,  $j3 = 46\mu\text{m}$ ,  $j4$  and  $j5 = 39\mu\text{m}$ ;  $z1 = 13\text{ mm}$ ,  $z3 = 35\mu\text{m}$ ,  $z4$  and  $z5 = 30\mu\text{m}$ ,  $z6 = 25\mu\text{m}$ ; setae of  $s$  row  $26\mu\text{m}$ ;  $r2 = 20\mu\text{m}$ ,  $r3 = 46\mu\text{m}$ . Opisthonotum with short setae from 7 to  $13\mu\text{m}$ .

Ventral idiosoma. Presternal plate ribbon-like, serrated especially on anterior margin; sternal shield reticulated, with a longitudinal strip medially; gland pore  $gv1$  located medially on posterior sternal margin (Fig. 12I). Length of sternal setae:  $st1 = 48\mu\text{m}$ ,  $st2$  from 48 to  $54\mu\text{m}$ ,  $st3 = 54\mu\text{m}$ . Paragynial shield with triangular posterolateral protrusions, their apex rounded (Fig. 12J). Anterior epigynium margin with large triangular apex, subapical epigynial structure formed by a well-sclerotized rectangular line and by a hyaline fan-like structure, spreading out like two wings (Fig. 12K). Endogynium a rounded cup with posterior margin forming a long slender protrusion; its tip bifid in some specimens (Fig. 12L, M, O). Length of ventral setae  $JV2 = 45\mu\text{m}$ ,  $JV3 = 30\mu\text{m}$ , others  $32\text{--}35\mu\text{m}$ .

Gnathosoma. Gnathotectum trispinate, with long central prong (Fig. 12N). Hypostomatic setae simple, palpcoxal setae slightly pilose. Pedipalps: trochanter with slight protuberance between pilose seta  $v1$  and thicker, barbed seta  $v2$ .

Legs. Coxa II with a rounded ridge of 6-8 denticles and an extra denticle.

### *Holoparasitus rifensis* sp. n.

Figs 13-14

TYPE MATERIAL: ♂ holotype, 5 ♂, 8 ♀ paratypes, MOROCCO, El Gouzat near Taineste, Rif mountains, 1500 m, soil under cork oak, 2.06.1978, leg. B.H.

ETYMOLOGY: The species name refers to the Rif mountain region.

DIAGNOSIS: Male. Both digits of chelicera with 6-7 denticles; arm of spermatotreme with small prominence located on inner side; gnathotectum with rounded apex and two tiny lateral prongs. Female: endogynium circular, cup-like with 6-8 denticles on anterior and lateral walls and with posterior margin protruded into one prolongation; epigynium with triangular, well sclerotized subapical structure with two small hyaline wings extended beyond epigynial apex.

DESCRIPTION: Male. Dorsal idiosoma. Cuticle brownish yellow. Length of podonotal seate from  $36\mu\text{m}$  ( $j1$ ,  $r3$ ),  $42\mu\text{m}$  ( $j$  row) to  $24\mu\text{m}$  ( $s4$ ); setae on opisthonotum from  $24\mu\text{m}$  to  $18\mu\text{m}$ .

Ventral idiosoma. Sternal shield without a particular pattern; length of sternal setae from 30 to  $36\mu\text{m}$ . Genital lamina with rectangular central prong and two triangular lateral extensions; subgenital sclerite rectangular (Fig. 13A). Gland  $gv2$  double. Length of ventral setae from  $30\mu\text{m}$  to  $36\mu\text{m}$ .



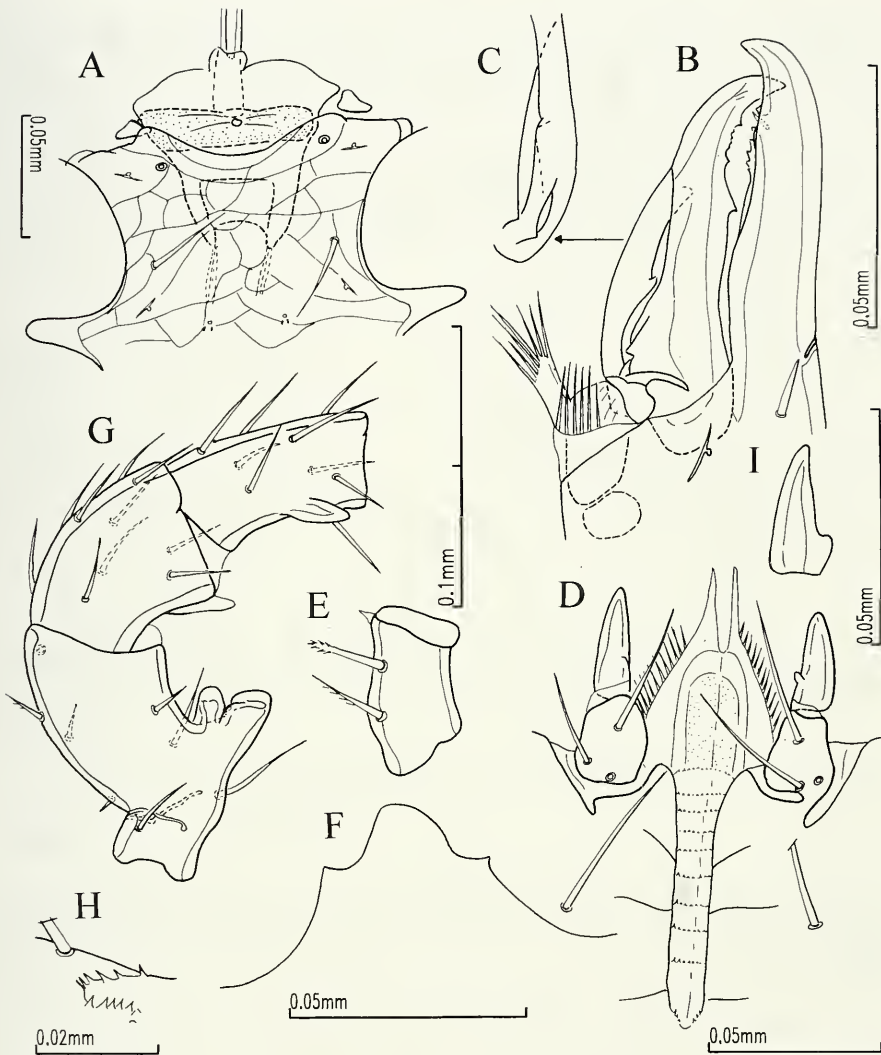


FIG. 13

*Holoparasitus rifensis* sp. n. male. (A) Genital lamina, microscлерite and anterior part of sternogenital shield. (B) Chelicera, antiaxial. (C) Spermatotreme, paraxial. (D) Hypognathum and corniculi. (E) Palptrochanter. (F) Gnathotectum. (G) Femur, genu, tibia of leg II. (H) Group of denticles on coxa II.

Gnathosoma. Gnathotectum with big, round central prong and two tiny lateral prongs (Fig. 13F). Corniculi with small prominence in their basal third; hypognathal groove with 10 rows of denticles; hypostomatic setae simple, palpcoxal setae pilose (Fig. 13D, I). Palptrochanter with pilose seta *v1* and thicker, barbed *v2* (Fig. 13E).

Chelicera (Fig. 13B-C). Fixed and movable digits with their apices curved and a row of 6-7 denticles on their inner margins. Arm of spermatotreme with small promi-

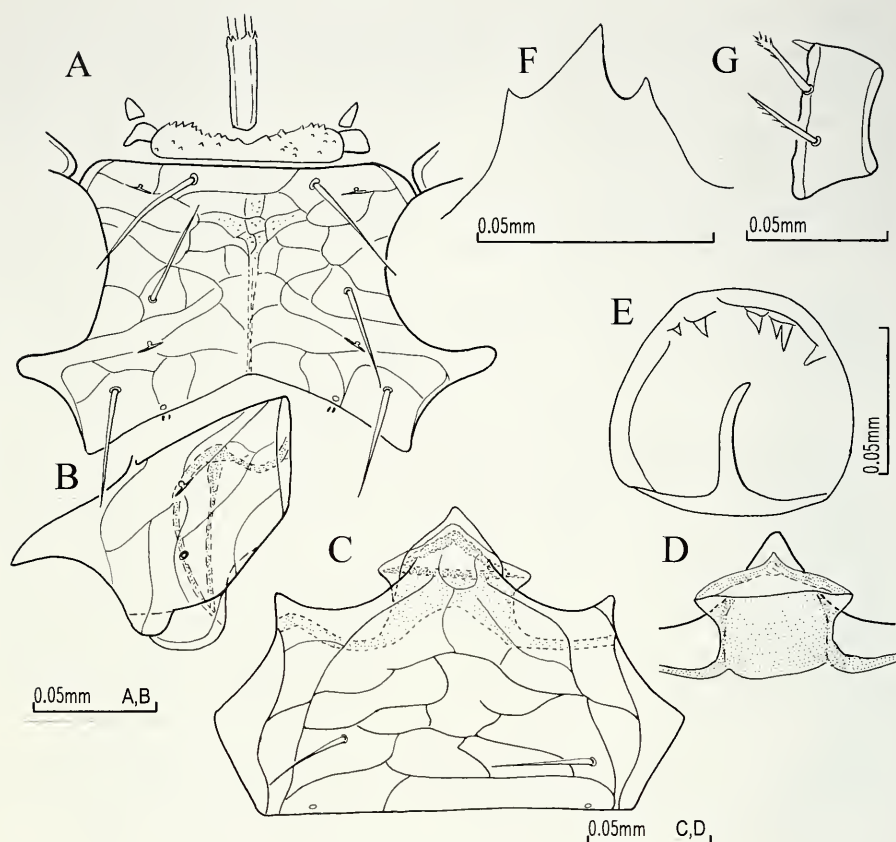


FIG. 14

*Holoparasitus rifensis* sp. n. female. (A) Presternal plate and sternal shield. (B) Paragynium. (C) Epigynum. (D) Apex of endogynium, dorsal view. (E) Endogynium. (F) Gnathotectum. (G) Palptrochanter.

nence located in its inner basal third; arthrodial membrane with short brush-like process.

Legs. Leg II: coxa with 6 to 12 denticles on two ridges, without basal denticle located near pore (Fig. 13H). Femoral apophysis and axillary process thumb-like; genu and tibia with triangular spurs (Fig. 13G). Apophysis on tibia appearing mucronate and rounded when squashed.

Female. Dorsal idiosoma. Colour brownish yellow, well-sclerotized. Length of podonotal setae from 36 to 42  $\mu\text{m}$  (*j* row), opisthonotal setae 12 to 18  $\mu\text{m}$ .

Ventral idiosoma. Presternal plate serrated, reticulation of sternal shield regular, with granular strip medially; length of sternal setae from 54  $\mu\text{m}$  (*st1*) to 48  $\mu\text{m}$  (*st2*, *st3*); gland pore *gv1* located medially on posterior margin (Fig. 14A). Paragynial shield reticulated with rounded posterolateral protrusions; metagynial sclerite almost straight (Fig. 14B). Epigynial shield with triangular apex; sclerotized subapical structure trian-

gular (like a Chinese hat in profile), with elongated hyaline wings extending beyond epigynial margin (Fig. 14C-D). Endogynium circular, cup-shaped, with 7-8 spines on anterior and lateral walls and with posterior margin forming a single straight or sometimes forked protrusion (Fig. 14E). Gland *gv2* double. Length of ventral setae from 36  $\mu\text{m}$  to 42  $\mu\text{m}$ .

Gnathosoma. Gnathotectum trispinate, lateral prongs small (Fig. 14F). Corniculi triangular. Hypognathal groove with 9-10 rows of denticles; hypostomatic setae simple, palpcoxal setae pilose. Palptrochanter with pilose seta *v1* and barbed seta *v2* (Fig. 14G).

Legs. Coxa II with a ridge of 7-8 denticles and a tiny basal denticle.

***Holoparasitus algiersensis* sp. n.**

Figs 15, 16A-B

TYPE MATERIAL: ♂ holotype, 2 ♀ paratypes, ALGERIA, east of Algiers, Rassauta swamp, littoral, 7.10.1956 (L. 102).

OTHER MATERIAL EXAMINED: 1 ♂, 2 ♀, ALGERIA, Algiers near "Maison Carée", vegetation under *Ulmus*, 12.05.1957 (L. 709). – 2 ♀, ALGERIA, Algiers, soil, garden of the geriatrics hospital, 12.05.1956 (LD. 874). – 2 ♂, ALGERIA, Algiers, "Ecole nationale agronomique" property, pine forest, leaf litter, 22.05.1960. All the material collected by C. Athias-Henriot.

ETYMOLOGY: The name species refers to the type locality, Algiers the capital of Algeria.

DIAGNOSIS: Male. Movable digit of chelicera with 2 teeth and 1 denticle between them, fixed digit straight, with truncate apex and inner margin with hump and one denticle. Female: apex of epigynium elongated, tongue-like; endogynium a small, simple sack.

DESCRIPTION: Male. Dorsal idiosoma. Cuticle well-sclerotized, colour reddish yellow. Length of setae on podonotal shield from 30-36  $\mu\text{m}$ , setae on opisthonotum small, 12  $\mu\text{m}$ .

Ventral idiosoma. Sternal shield reticulated with two concave sclerotized lines between *st1* and *st2*; length of sternal setae about 40-42  $\mu\text{m}$ . Rectangular sclerotized strip on internal anterior margin of sternogenital shield between protuberances delimiting genital concavity. Genital lamina rounded, with two small lateral prongs; anterior margin and central part well sclerotized (Fig. 16A, B). Rectangular and well-sclerotized microsclerite bearing tritosternum. Gland *gv2*, simple (Fig. 15K).

Gnathosoma. Gnathotectum with three prongs, median longer than lateral ones (Fig. 15F). Hypognathal groove with 9 rows of very fine denticles; palpcoxal seta finely pilose, hypostomatic setae simple; corniculi triangular, with small prominence situated paraxially (Fig. 15C, D). Palptrochanter with simple seta *v1* and slightly pilose *v2* (Fig. 15D).

Chelicera (Fig. 15A, B). Movable digit with three teeth and denticle between them. Specimens from slide LD 887 only with two big teeth; short spermatotreme ending distally at level of basal tooth; arthrodial membrane with short brush-like process paraxially. Fixed digit straight, apex truncate, its inner margin with membranous hump and denticle near pilus dentilis

Legs. Coxa II with ridge bearing 7-8 denticles. Leg II armed as follows (Fig. 15E): short thumb-like, femoral apophysis and trapezoidal axillary process; triangular





spur located distally on genual margin; trapezoidal tibial apophysis ending nearly at distal margin of segment.

Female. Dorsal idiosoma as in male. Length of setae on podonotal region  $24\ \mu\text{m}$  (row *j*),  $24\text{--}30\ \mu\text{m}$  other,  $30\text{--}36\ \mu\text{m}$  (*jl*); setae on opisthonotal region shorter,  $12\ \mu\text{m}$ .

Ventral idiosoma. Presternal plate ribbon-like, with slightly denticulate anterior margin; sternal shield reticulated, length of sternal setae from  $45\ \mu\text{m}$  to  $54\ \mu\text{m}$ ; gland pore *gv1* absent (Fig. 15G, I). Paragynial shield reticulated, posterolateral protrusions rounded (Fig. 15H). Epigynial shield with tongue-like apex and two lateral spines (Fig. 15H). Endogynium small, sack-like, with two tiny lateral prolongations (Fig. 15J). Length of ventral setae from  $30$  to  $36\ \mu\text{m}$ . Gland *gv2* simple.

Gnathosoma. Gnathotectum trispinate (Fig. 15M). Hypognathal groove with 10 rows of denticles, the last four oligodent; hypostomatic setae simple, palpcoxal seta pilose.

Pedipalp. Border of trochanter thickened between pilose seta *v2* and simple seta *v1* (Fig. 15L).

Legs. Denticulated ridge on coxa II with 8 denticles.

***Holoparasitus eivissa* sp. n.**

Figs 16C, 17

TYPE MATERIAL: ♂ holotype, SPAIN, Ibiza, road between St Juan and St Miguel, pine forest, sifting of leaf litter and soil, 20.09.2006, leg. I. Juvara-Bals. – 4 ♀ paratypes, San Miguel, Ibiza, small field with almond trees, leaf litter and dry soil, 10.04.1960, leg. H.F. (Sp. 720).

ETYMOLOGY: The species name is given the catalane name (Eivissa) of Ibiza, noun in apposition.

DIAGNOSIS: Gland *gv1* absent. Male: fixed digit straight and toothless; movable digit with three teeth. Genital lamina well-sclerotized on inner face, with rounded lateral margins and bifurcate central prong. Female: apex of epigynium rounded, sclerotized subapical structure in the form of an inverted T; sack-like, rounded endogynium with sclerotized central part.

DESCRIPTION: Male. Dorsal idiosoma. Colour reddish brown. Length of idiosomal setae: on podonotum from  $30$  to  $36\ \mu\text{m}$  except for seta *z1*  $12\ \mu\text{m}$ ; length of opisthonotal setae  $18$  to  $24\ \mu\text{m}$ , lateral setae of row *R* very short,  $12\ \mu\text{m}$ .

Ventral idiosoma. Sternogenital shield reticulated. Anterior margin of sternal shield with two well-sclerotized protuberances. Genital lamina with two small prongs on anterior margin and rounded lateral angles; its inner side with two lateral and one median heavily sclerotized formations. Sclerotized central structure continued on posterior side with a sclerotized element attached to inner side of anterior margin of sternal shield (Fig. 16C). Microsclerite pentagonal. Gland *gv1* absent, gland *gv2* simple. Length of sternal and ventral setae from  $30$  to  $36\ \mu\text{m}$ .

Gnathosoma. Gnathotectum trispinate, with long central prong and tiny lateral ones (Fig. 17C). Corniculi with proximal protuberance (Fig. 17D). Simple hypostomatic and pilose palpcoxal setae; hypognathal groove with 9 rows of denticles. Palptrochanter with simple seta *v1* and pilose seta *v2* (Fig. 17D).

Chelicera (Fig. 17A, B). Fixed digit straight, its inner margin toothless except for one tiny tooth situated distally near pilus dentilis. Movable digit with curved apex

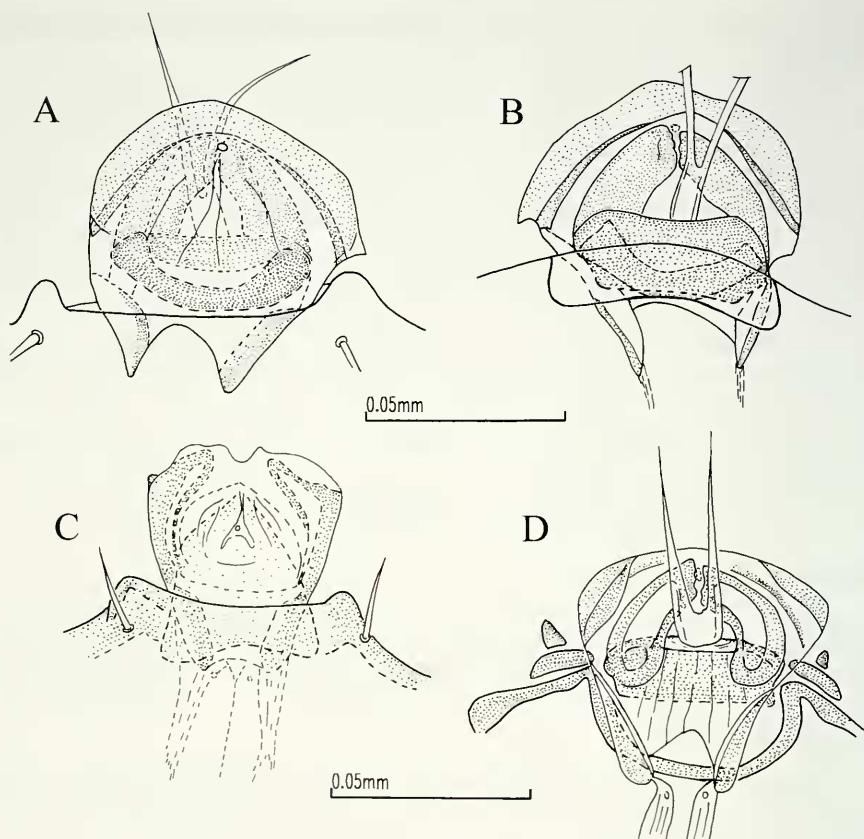


FIG. 16

Anterior margin of sternogenital shield, genital lamina and microscлерite. (A, C) ventral view, (B, D) dorsal view. (A-B) *Holoparasitus algiersensis* sp. n. (C) *Holoparasitus eivissa* sp. n. (D) *Holoparasitus singularis* sp. n.

and three teeth; spermatotreme straight. Arthrodistal membrane with short brush-like process.

Legs. Armature of leg II (Fig. 17E): femoral apophysis and axillary process short and rounded; ellipsoidal genual apophysis and elongated tibial apophysis situated near distal margin of respective segment. Trochanter IV with ventral protuberance (Fig. 17F).

Female. Dorsal idiosoma. Colour brownish yellow. Length of setae on podonotum:  $r5 = 42 \mu\text{m}$ , others around  $24$  to  $30 \mu\text{m}$ ; setae on opisthonotum short, their length around  $18 \mu\text{m}$ .

Ventral idiosoma. Presternal plate ribbon-like, serrated; sternal shield reticulated, with a concave line above seta *st2*; gland *gv1* absent (Fig. 17G). Paragynia with big rounded posterior protrusion; large triangular metagynial sclerite (Fig. 17I). Epigynum with round apex and sclerotized subapical structure in the form of an inverted T (Fig. 17H). Endogynum with a sclerotized opening presumably connected

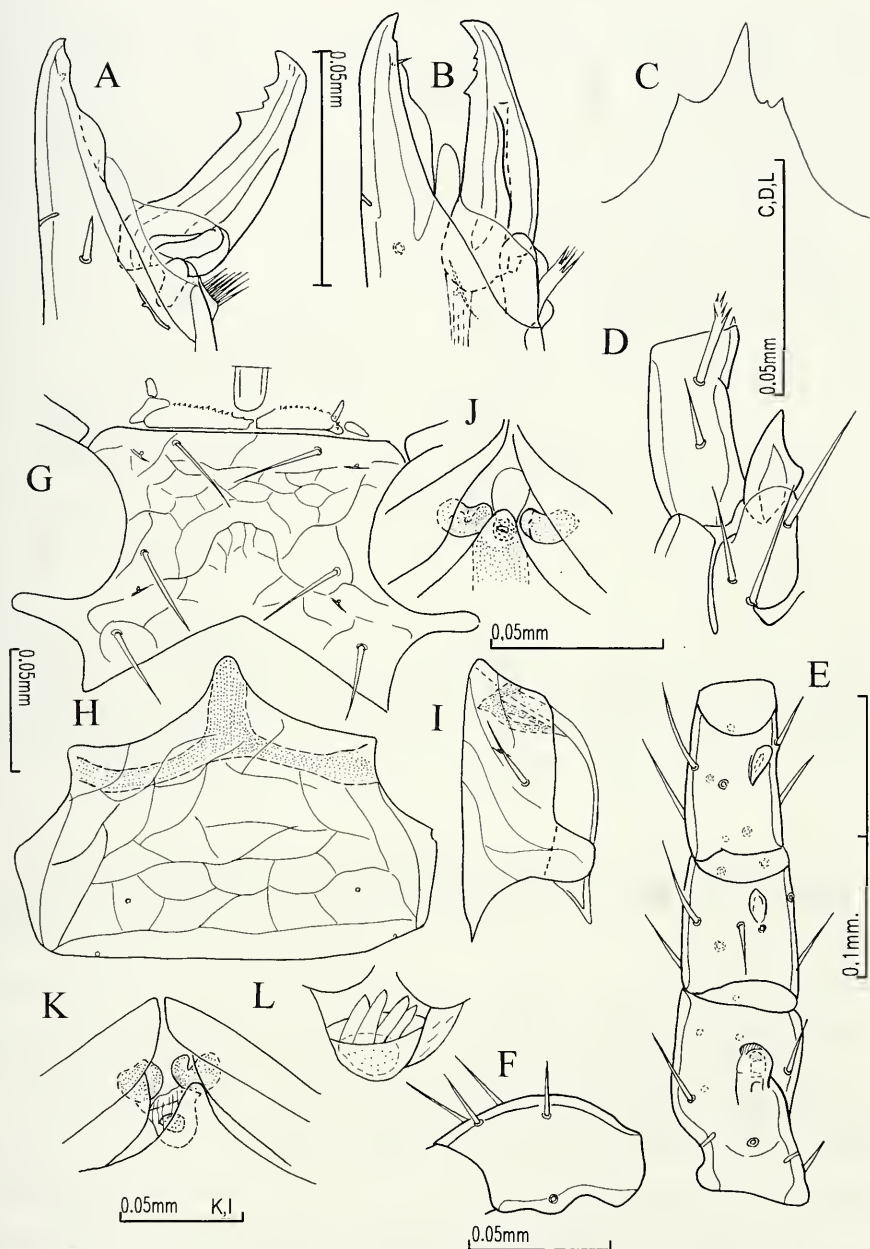


FIG. 17

*Holoparasitus eivissa* sp. n. male (A-F). (A) Chelicera, antiaxial view. (B) Chelicera, paraxial view. (C) Gnathotectum. (D) Palptrochanter and corniculus. (E) Femur, genu, tibia of leg II, ventral view. (F) Trochanter IV. Female (G-L). (G) Presternal plate and sternal shield. (H) Epigynum. (I) Paragynium. (J, K, L) Endogynium.

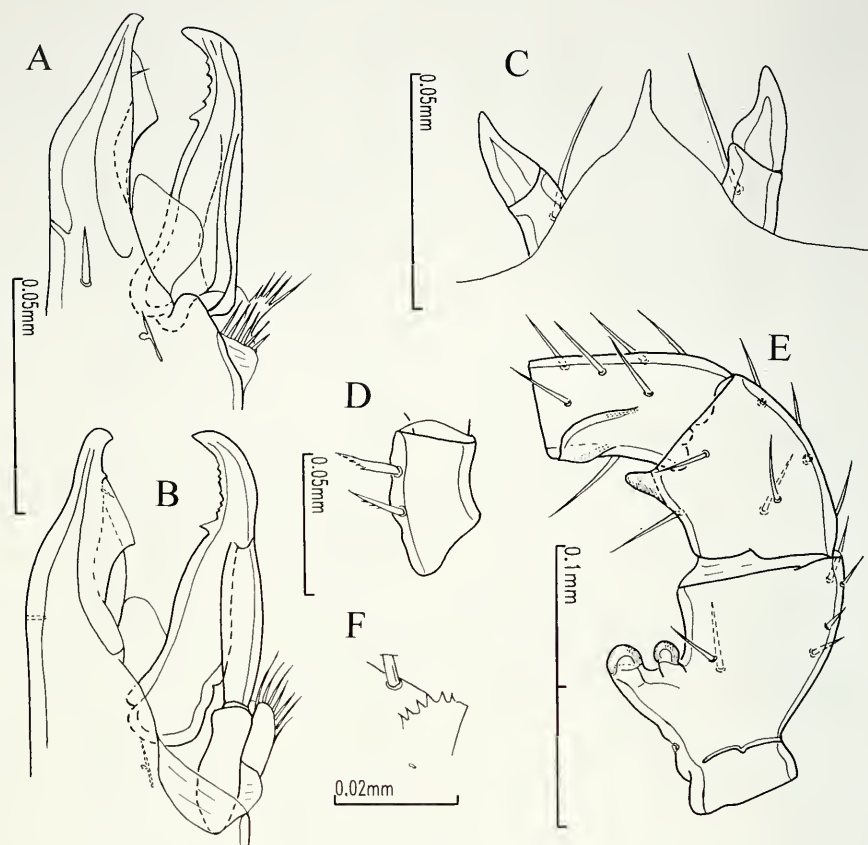


FIG. 18

*Holoparasitus singularis* sp. n. male. (A) Chelicera, antiaxial view. (B) Chelicera, paraxial view. (C) Gnathotectum and corniculi. (D) Palptrochanter. (E) Femur, genu, tibia of leg II. (F) Group of denticles on coxa II.

to a small sack (Fig. 17 J, K, L). Gland *gv2* simple with a tiny pore; length of sternal setae  $48\mu\text{m}$  and of ventral setae around  $36\mu\text{m}$ .

Gnathosoma. Hypostomatic setae simple, palpcoxal setae slightly pilose. Palptrochanter with simple seta *v1* and pilose seta *v2*.

REMARK: The female specimens (4 slides) are not in good condition so that the characters of the gnathosoma could not be studied in detail.

***Holoparasitus singularis* sp. n.**

Figs 16D, 18

TYPE MATERIAL: ♂ holotype, 2♂ paratypes, ALGERIA, "Sahel d'Alger", Oued Bouzariah, valley, east side, laurel forest, 0-5 cm deep soil, 3.01.1961, leg.C. Athias-Henriot (LB. 636).

OTHER MATERIAL EXAMINED: 1♂, ALGERIA, Kaddaous, Hydra, pine forest, leaf litter and soil, 6.11.1960, leg. C. Athias-Henriot (LD. 960).

ETYMOLOGY: The species name refers to the particular morphology of its chelicera.



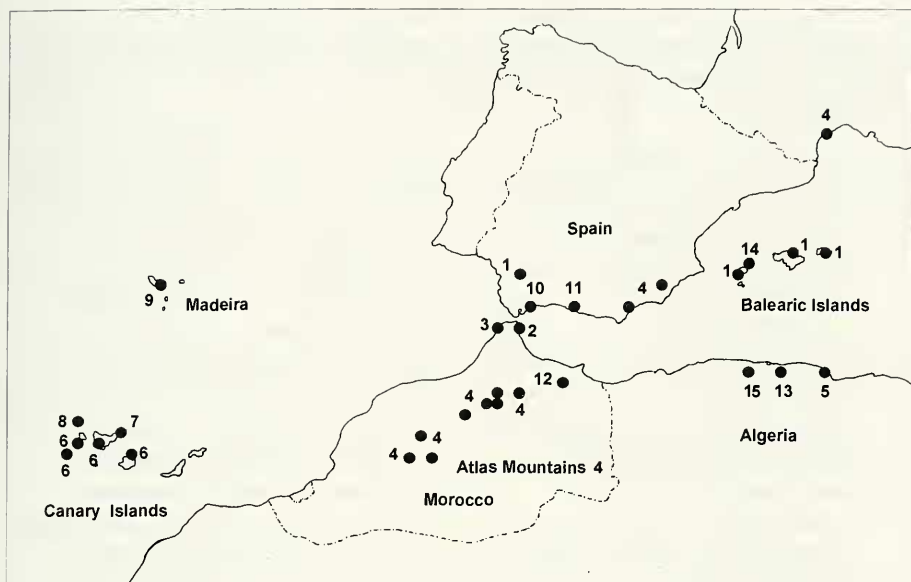


FIG. 19

Distribution of *Holoparasitus mallorcae* Juvara-Bals and the new species of the *H. mallorcae* species-group. (1) *H. mallorcae* Juvara-Bals. (2) *H. mahnerti* sp. n. (3) *H. vaucheri* sp. n. (4) *H. franzi* sp. n. (5) *H. variabilis* sp. n. (6) *H. canariensis* sp. n. (7) *H. anaga* sp. n. (8) *H. lapalma* sp. n. (9) *H. giganteus* sp. n. (10) *H. lunae* sp. n. (11) *H. malleus* sp. n. (12) *H. rifensis* sp. n. (13) *H. algiersensis* sp. n. (14) *H. eivissa* sp. n. (15) *H. singularis* sp. n.

**DIAGNOSIS:** Gnathotectum triangular. Chelicera: fixed digit toothless, its inner margin with triangular formation; hooked movable digit with 5-7 denticles. Gland *gvI* absent.

**DESCRIPTION:** Only the male is known. Not all the characteristics are visible on the slides from the collection of Athias-Henriot.

**Dorsal idiosoma.** Small species, colour brownish yellow. Length of podonotal setae from 30  $\mu\text{m}$  (*jI*) to 24  $\mu\text{m}$ ; setae on opisthonotum very short, 10-12  $\mu\text{m}$ .

**Ventral idiosoma.** Reticulation simple. Genital lamina rounded, located in deep concavity of sternal margin; inner face of genital lamina with a horseshoe-shaped sclerotization (Fig. 16D). Large subgenital microsclerite bearing tritosternum. Gland *gvI* usually absent; one specimen with single gland on one side.

**Gnathosoma.** Gnathotectum triangular (Fig. 18C). Hypognathal groove with 10 denticulate rows; simple hypostomatic setae located on a tiny protuberance; palpcoxal setae pilose. Palptrochanter with simple seta *vI* and pilose seta *v2* (Fig. 18D).

**Chelicera** (Fig. 18A, B). Fixed digit toothless, with enlarged basis and slender apex; on its inner margin a triangular formation. Movable digit with hooked apex and 5-7 denticles on inner margin; small brush-like process on arthrodial membrane; spermatotreme straight.

Legs. Coxa II with fan-like ridge formed by 7-8 denticles (Fig. 18F). Armature of leg II (Fig. 18E): straight, thumb-like femoral apophysis and short, rounded axillary process; triangular genual spur situated on distal margin of segment; tibial apophysis large, mucronate.

# KEY TO SPECIES OF THE “*HOLOPARASITUS MALLORCAE*” SPECIES GROUP.

## Males

- 1a Genital lamina rounded, well-sclerotized on inner face; large trapezoidal microsclerite bearing tritosternum, gland *gv1* absent . . . . . 2
- 1b Genital lamina with lateral angles, not or only slightly sclerotized on inner face; microsclerite rectangular, gland *gv1* present . . . . . 4
- 2a Gnathotectum trispinate; fixed digit of chelicera straight with hump on inner margin; movable digit with two or three small teeth . . . . . 3
- 2b Gnathotectum triangular, with long central prong; fixed digit of chelicera with a large basis, a slender hooked apex and a triangular extension on inner margin; movable digit with 5-7 denticles and one tooth; Algeria . . . . . *H. singularis* sp. n.
- 3a Anterior margin of genital lamina with central prong; movable digit of chelicera with 3 teeth; fixed digit with pilus dentilis near slightly curved apex; Spain: Ibiza . . . . . *H. eivissa* sp. n.
- 3b Anterior margin of genital lamina without central prong; movable digit of chelicera with 2 teeth; fixed digit straight, with truncate apex and pilus dentilis located medially; Algeria . . . . . *H. algiensis* sp. n.
- 4a Gnathotectum trispinate, “three prongs type” . . . . . 5
- 4b Gnathotectum otherwise, “lobe type”, with central prong large, triangular or rounded, flanked by small lateral spines or triangular prongs . . . . . 8
- 4c Gnathotectum as a simple triangular process, its apex more or less rounded . . . . . 13
- 5a Fixed digit of chelicera straight, its apex slightly hooked and with denticles around pilus dentilis; movable digit straight, with apex slightly hooked and denticles on inner face . . . . . 6
- 5b Fixed digit straight, with few or no denticles on inner face; movable digit otherwise . . . . . 7
- 6a Palptrochanter with seta *v1* simple, *v2* barbed, between them a protuberance; movable digit of chelicera carrying 3-4 denticles and one tooth, arm of spermatotreme straight; genu II with triangular apophysis; Spain: Balearic Islands, Andalusia . . . . . *H. mallorcae* Juvara-Bals, 1975
- 6b Palptrochanter with *v1* pilose, *v2* barbed, without intermediate protuberance; movable digit of chelicera carrying 5-6 denticles and one tooth, arm of spermatotreme arched; genu II with rectangular apophysis; Algeria: Djurdjura . . . . . *H. variabilis* sp. n.
- 7a Gnathotectum with triangular central prong; movable digit with a big tooth medially on internal margin and a rounded hump on external margin; fixed digit with denticles only in distal third; Spain: Andalusia . . . . . *H. gibber* Juvara-Bals & Witalinski, 2000

- 7b Gnathotectum with long and sinuous central prong; movable and fixed digits straight, without denticles or teeth; England, Ireland, North of Spain . . . . . *H. lawrencei* Hyatt, 1987
- 8a Gnathotectum with central prong large and rounded, lateral prongs small, with minute spines . . . . . 9
- 8b Gnathotectum with central prong tongue-like and lateral prongs small . . . . . 10
- 8c Gnathotectum with rounded prominent central prong and lateral prongs large, triangular, forming an angle with basis of central prong . . . . . 12
- 9a Corniculi conical; palptrochanter with protuberance between pilose  $v1$  and barbed  $v2$ ; movable digit of chelicera with 6 denticles; genital lamina with bilobate central prong and undulating margin of lateral lobes; Italy: Sicily . . . . . *H. ellipticus* Juvara-Bals & Witalinski, 2000
- 9b Corniculi with tubercle in distal third; palptrochanter with small prominence between pilose  $v1$  and barbed  $v2$  and with a protuberance under  $v1$ ; movable digit of chelicera with 3 denticles; genital lamina with simple lateral lobes; Morocco . . . . . *H. mahnerti* sp. n.
- 10a Apex of movable digit bearing a prominence on ventral side at end of spermatotreme; palptrochanter with  $v1$  simple, located on a prominent, digitiform tubercle; corniculi simple; Spain, Morocco . . . . . *H. franzi* sp. n.
- 10b Apex of movable digit without prominence; palptrochanter with  $v1$  pilose, not located on tubercle; corniculi with prominence in proximal third . . . . . 11
- 11a Arm of spermatotreme arched, with small internal protuberance and a large brush-like process;  $tI$  = 151-156  $\mu m$ ,  $tIV$  = 168-178  $\mu m$ ; Morocco . . . . . *H. rifensis* sp. n.
- 11b Arm of spermatotreme straight and a short brush-like process;  $tI$  = 138-145  $\mu m$ ,  $tIV$  = 149  $\mu m$ ; Spain: Andalusia . . . . . *H. lunae* sp. n.
- 12a Fixed digit of chelicera straight, with curved apex and 6-8 denticles around pilus dentilis; movable digit with 6 denticles and arched arm of spermatotreme, brush-like process long; palptrochanter with sharp protuberance between pilose  $v1$  and barbed  $v2$ ; corniculi elongated, with tubercle near their bases;  $tI$  = 172-180  $\mu m$ ,  $tIV$  = 192-197  $\mu m$ ; Morocco: Tangier . . . . . *H. vaucheri* sp. n.
- 12b Fixed digit hammer-like, 5 denticles between pilus dentilis and curved apex; movable digit with 4 denticles and small tooth, brush-like process on arthrodial membrane short; palptrochanter with simple  $v1$  located on tubercle and barbed  $v2$ ; corniculi with small protuberance located medially;  $tI$  = 158-168  $\mu m$ ;  $tIV$  = 168-180  $\mu m$ ; Spain: Andalusia . . . . . *H. malleus* sp. n.
- 13a Gnathotectum produced into a triangular process; big species 680-750  $\mu m$  long; Great Britain, Spain: Madeira, Tenerife . . . . . *H. maritimus* Hyatt, 1987
- 13b Gnathotectum produced into a prominent, more or less rounded, process; Canary Islands, Madeira . . . . . 14
- 14a Apex of gnathotectum truncated; chelicera with large and straight fixed digit bearing 6 fine denticles between pilus dentilis and apex; Tenerife . . . . . *H. anaga* sp. n.

- 14b Apex of gnathotectum rounded; chelicera with straight and truncate fixed digit, inner margin with 7-10 denticles around pilus dentilis . . . . . 15
- 15a Palptrochanter with simple *v1*, pilose *v2*, without protuberances between them; leg II with oval genual apophysis; distance of the trapezoidal tibial apophysis to the margin of the segment 22  $\mu\text{m}$ ; big species, *tI* = 242-247  $\mu\text{m}$ , *tIV* = 271  $\mu\text{m}$ ; Madeira . . . . . *H. giganteus* sp. n.
- 15b Palptrochanter with pilose *v1*, barbed *v2*, and sharp protuberance between them; leg II with different apophysis; distance of the tibial apophysis to the anterior margin of tibia 12-18  $\mu\text{m}$ ; Canary Isles . . . . . 16
- 16a Gnathotectum rounded, some specimens with two tiny spines laterally; fixed digit with 7 denticles around pilus dentilis; leg II with small, triangular genual apophysis and trapezoidal tibial apophysis; *tI* = 168-194  $\mu\text{m}$ ; *tIV* = 192-228  $\mu\text{m}$ ; Canary Islands . . . . . *H. canariensis* sp. n.
- 16b Gnathotectum tongue-like; chelicera with fixed digit bearing 5 small denticles above pilus dentilis; leg II with big, prominent genual apophysis located on distal margin and tibial apophysis mucronate; *tI* = 204-228  $\mu\text{m}$ , *tIV* = 228-247  $\mu\text{m}$ ; Canary Isles: La Palma . . . . *H. lapalma* sp. n.

#### Females

- 1a Endogynium a small sack; epigynium with rounded apex, lateral prongs not very sharp, subapical structure of epigynium without membranous structures; gland *gv1* absent . . . . . 2
- 1b Endogynium cup-like, with curtain-like structures, with fleshy lobes or with one or two protrusions on its posterior margin; epigynium with triangular apex and salient lateral prongs, subapical structure of epigynium with membranous structures; gland *gv1* present . . . . . 3
- 2a Endogynium a sack with dentate anterior margin; epigynial ratio *h/b*=0.95; Algeria . . . . . *H. algiensis* sp. n.
- 2b Endogynium a sack with a round sclerotized part in its middle; epigynial ratio *h/b*=0.83; Spain: Ibiza . . . . . *H. eivissa* sp. n.
- 3a Endogynium with many internal teeth and two big curved denticulated protrusions; epigynium with mucronate apex; *tI* = 192  $\mu\text{m}$ , *tIV* = 228-240  $\mu\text{m}$ ; England, Ireland . . . . . *H. lawrencei* Hyatt, 1987
- 3b Endogynium otherwise, with curtain-like structures or protrusions on its posterior margin; epigynium with rounded or triangular apex . . . . . 4
- 4a Endogynium with two membranous curtain-like structures or two fleshy lobes . . . . . 5
- 4b Endogynium with one or two protrusions on posterior margin . . . . . 6
- 5a Endogynium with two membranous curtain-like structures; epigynium with large triangular apex, rounded subapical structure with two tiny oval extensions near apex basis; Morocco . . . . . *H. mahnerti* sp. n.
- 5b Endogynium with two fleshy lobes; epigynium with short broad tip, subapical structure rectangular, with two membranous triangular extensions near apex; Great Britain, Madeira, Tenerife . . . . . *H. maritimus* Hyatt, 1987
- 6a Endogynium with one protrusion on posterior margin . . . . . 7



- 6b Endogynium with two protrusions on posterior margin . . . . . 9
- 7a Endogynium with one finger-like protrusion and 6-7 denticles on its lateral walls; Morocco . . . . . *H. rifensis* sp. n.
- 7b Endogynium with one protrusion but without denticles on its walls . . . . . 8
- 8a Apex of finger-like protrusion sharp; apex of epigynium mucronate; epigynial subapical structure trapezoidal and well sclerotized, with small hyaline extensions; Spain: Sierra de Luna . . . . . *H. lunae* sp. n.
- 8b Apex of slender protrusion sharp or bifid; large and triangular apex of epigynium; epigynial subapical structure formed by a sclerotized rectangular line under apex and by two fan-like hyaline extensions; Spain: Malaga . . . . . *H. malleus* sp. n.
- 9a Presternal plate not serrated, endogynium with two short posterior protrusions ( $a = 40-48 \mu\text{m}$ ) apart from other:  $60 \mu\text{m}$ ; big species  $\text{tI} = 240-252 \mu\text{m}$ ,  $\text{tIV} = 264-297 \mu\text{m}$ ; Spain: Madeira . . . . . *H. giganteus* sp. n.
- 9b Presternal plate more or less distinctly serrated, endogynial protrusions of different shape and size,  $\text{tI} = 144-228 \mu\text{m}$ ,  $\text{tIV} = 151-257 \mu\text{m}$  . . . . . 10
- 10a Presternal plate with few denticles, gland pore *gvI* located on soft cuticle or on posterior margin; endogynial protrusions involute, unequal in size and distant to each other; epigynium with well-protruded triangular apex and a subapical structure with a conspicuous sclerotized line continued by two trapezoidal membranous wings;  $\text{tI} = 204-228 \mu\text{m}$ ;  $\text{tIV} = 252-264 \mu\text{m}$ ; Spain: La Palma . . . . . *H. lapalma* sp. n.
- 10b Presternal plate distinctly serrated; gland-pore *gvI* always located on sternal shield near posterior margin; endogynial protrusions well developed; epigynial apex triangular but not protruded, subapical structure otherwise . . . . . 11
- 11a Endogynium with two protrusions of different length, their bases very close to each other or with one bifid protrusion (Fig. 4M-N); Algeria: Djurdjura . . . . . *H. variabilis* sp. n.
- 11b Endogynium with two equal protrusions . . . . . 12
- 12a Gnathotectum large, triangular; large cup-like endogynium with two fine protrusions, their apices oriented medially and away from each other; trochanter IV with ventral protuberance; Tenerife: Anaga Mountains . . . . . *H. anaga* sp. n.
- 12b Gnathotectum trispinate; endogynium otherwise; trochanter IV without protuberance . . . . . 13
- 13a Endogynium with two horn-like or triangular protrusions . . . . . 14
- 13b Endogynium with two finger-like, more or less, long protrusions . . . . . 15
- 14a Endogynium with two short straight horn-like protrusions; epigynial apex large, not prominent, subapical structure with oval wings; palptrochanter with pilose *vI*, barbed *v2*, between them a protuberance; epigynial ratio  $h/b = 0.70$ ; Morocco- Tangier . . . . . *H. vaucheri* sp. n.
- 14b Endogynium with two triangular protrusions; epigynial apex large, prominent; epigynial subapical structure extending into fan-like wings; epigynial ratio  $h/b = 0.85$ ; Spain, Morocco: Atlas Mountains . . . *H. franzi* sp. n.

- 15a Endogynium with teeth on lateral and anterior walls, endogynial long protrusions straight or sinous, their tips reaching at anterior margin of endogynium and their bases close to each other;  $tI = 156-180 \mu m$ ,  $tIV = 173-198 \mu m$  . . . . . 16
- 15b Endogynium without teeth, straight and short ( $a = 25-30 \mu m$ ) endogynial protrusions with a gap of  $40-45 \mu m$  between their bases;  $tI = 184-199 \mu m$ ,  $tIV = 204-297 \mu m$ ; Canary Islands . . . . . *H. canariensis* sp. n.
- 16a Endogynium with straight ( $a=34 \mu m$ ) protrusions, distance between their bases  $10 \mu m$ ; palptrochanter with simple  $v1$ , barbed  $v2$  and a protuberance between them; Spain: Balearic Islands . . . . . *H. mallorcae* Juvara-Bals, 1975
- 16b Endogynium with sinous and long protrusions ( $45 \mu m$ ), their bases very close each to another; palptrochanter with pilose  $v1$  and barbed  $v2$  . . . . . 17
- 17a Endogynium lateral walls with 2 teeth, epigynial ratio= 0.92; Spain: Seville . . . . . *H. gibber* Juvara-Bals & Witalinski, 2000
- 17b Endogynium lateral and superior walls with 3-7 denticles; epigynial ratio  $h/b=0.89$ ; Italy: Sicily . . . . . *H. ellipticus* Juvara-Bals & Witalinski, 2000

## RELATIONSHIPS

The opportunity to study the rich material deposited in the collection of the MNHG has enlarged our knowledge about the complexity and the diversification of the genus *Holoparasitus*.

The species described in this paper shares a number of characters, which includes them in the *H. mallorcae* species-group. As a result of all the newly discovered species, and of the revisions of some Berlese types (Hyatt, 1987; Juvara-Bals & Witalinski, 2000; Witalinski & Skorupski, 2002) this species group as established by Juvara-Bals & Witalinski (2000) has to be redefined as follows.

Male: Sternogenital shield without excipulum; hypostomatic setae insereted on distinct piece of cuticle separated by incisions, hypostome more or less distinctly extended between corniculi; coxa II anterolaterally provided with a denticulated ridge and a basal denticle; main apophysis and axillary process of femur II thumb-like and short.

Female: Presternal plate provided with denticles, lateral platelets free; paragynia without sclerotized elliptical thickenings facing coxa III; chelicera with 3 teeth on movable digit and 5 denticles on fixed digit; opening of gland  $gv2$  in smooth cuticle.

This short diagnosis will probably be modified after the description of still unknown taxa from other parts of southern Europe, Asia and North Africa. Characters, which allow to distinguish females of different species are the structure of the endogynium, the shape of the subapical structure of the epigynium and, to a lesser extent, the shape of the posterior paragynial lobe and the epigynial ratio  $h/b$ . The species treated here posses several types of endogynia which characterize the different lineages:

- endogynium cup-shaped, with two protrusions on its posterior margin and sometimes with denticles on the lateral walls (*H. mallorcae* Juvara-Bals, *H. gibber*

Juvara-Bals & Witalinski, *H. ellipticus* Juvara-Bals & Witalinski, *H. canariensis* sp. n., *H. lapalma* sp. n., *H. anaga* sp. n., *H. giganteus* sp. n., *H. variabilis* sp. n.).

- endogynium cup-shaped, with two triangular protrusions on posterior margin (*H. franzi* sp. n., *H. vaucheri* sp. n.).

- endogynium cup-shaped, with one protrusion on the posterior margin, and the lateral walls in some species provided with denticles (*H. lunae* sp. n., *H. malleus* sp. n., *H. rifensis* sp. n.).

- endogynium cup-shaped, with different structures (*H. maritimus* Hyatt, *H. mahnerti* sp. n., *H. lawrencei* Hyatt).

- endogynium a small, simple sack (*H. algiensis* sp. n., *H. eivissa* sp. n.).

The heptagonal epigynium occurs in two distinct types: one, characteristic for the majority of taxa included in the *H. mallorcae* species-group, with very sharp lateral angles and a subapical structure with membranous wings of various forms extending over the apex margin; the other without angular lateral angles and with a sclerotization under the apex in the form of an inverted T. This last type is associated with a simple sack-like endogynium and the lack of gland *gv1* (in *H. algiensis* sp. n. and *H. eivissa* sp. n.).

The characteristics of the gnathotectum and those of the chelicera make the males easily distinguishable. Three forms of the gnathotectum can be observed:

- trispinate with a slender central prong and two similar and shorter lateral ones (*H. gibber* Juvara-Bals & Witalinski, *H. mallorcae* Juvara-Bals, *H. lawrencei* Hyatt, *H. variabilis* sp. n., *H. ellipticus* Juvara-Bals & Witalinski, *H. algiensis* sp. n., *H. mahnerti* sp. n.).

- trifid with a tongue-like central prong and two short, more or less, triangular lateral ones (*H. lunae* sp. n., *H. malleus* sp. n., *H. franzi* sp. n., *H. rifensis* sp. n., *H. vaucheri* sp. n.).

- one single prominent protrusion, rounded or triangular (*H. lapalma* sp. n., *H. canariensis* sp. n., *H. anaga* sp. n., *H. giganteus* sp. n., *H. maritimus* Hyatt).

Another character that differentiates the males is the shape of the chelicera. The fixed digit has two different forms:

- apex hooked and inner margin with denticles or oligodont.

- straight and toothless or oligodont.

The movable digit is generally hooked, but can also be straight and toothless (*H. lawrencei* Hyatt), carries denticles (*H. mallorcae* Juvara-Bals, *H. vaucheri* sp. n.) or is oligodont (*H. algiensis* sp. n.); its external margin has a hump (*H. gibber* Juvara-Bals & Witalinski); the apex is provided with a prominence (*H. franzi* sp. n.). The length of the spermatotreme is different from one species to another,

Generally the form of the gnathotectum in males is not correlated with that of the endogynium in females. However, it can be noted that in *H. lunae* sp. n. and in *H. rifensis* sp. n. the female possesses an endogynium with one protrusion and the male a gnathotectum with one central lobe-like apex and two small lateral prongs. All four species described from the Canary and Madeira Islands have the male gnathotectum protuberant, more or less, rounded and the female endogynium with two protrusions on the posterior margin.

I consider as plesiomorphic the following character states of males: the trifid gnathotectum, the chelicera with hooked apex and with tooth and denticles on the inner



margin of fixed and movable digits, corniculi simple and stalked, the palptrochanter with simple *v1* and barbed *v2* and a rectangular microsclerite bearing tritosternum.

According to my opinion the plesiomorphic characters in females are the trifid gnathotectum, the chelicera with three teeth on the movable digit and five denticles on the fixed digit, the simple ribbon-like presternal plate and the endogynium with two protrusions on its posterior margin. *H. mallorcae* Juvara-Bals from the Balearic Islands possesses most of these characteristics; the only derived character is a protuberance on the corniculi instead of simple conical shape.

The presumably monophyletic *H. mallorcae* species-group currently includes two different lineages. *H. algiensis* sp. n., *H. eivissa* sp. n., *H. singularis* sp. n. form a lineage characterized by the lack of gland *gv1* in both sexes. The females are distinguishable by the small sack-like endogynium with a round opening and by the form of the epigynium and its inverted T-shaped sclerotization of the subapical structure. In males the form of the chelicera as well as the heavily sclerotized genital lamina and subgenital microsclerite are easily discernible. These species seems to be closer to *H. sardensis* Juvara-Bals & Witalinski, 2006 and *H. annulus* Juvara-Bals & Witalinski, 2006 from Sardinia and North Africa, respectively. The second lineage comprises the other species mentioned in this paper in which the gland *gv1* is present; the females of these species possess a cup-shaped endogynium with various structures (protrusions, lobes) on the posterior margin, and the epigynium has a sclerotized subapical structure with membranous structures. The genital lamina in males of that second evolutionary lineage has a central prong and a weak sclerotization on the posterior face. The rectangular or trapezoidal microsclerite is not very large.

The only clearly apomorphic character in females of the *H. mallorcae* species-group is the serrated presternal plate. This character also appears in *H. annulus* Juvara-Bals & Witalinski, one of the two species included in the *H. annulus* species-group. This species shows strong intraspecific variation in the number of denticles on the presternal plate which seems to be an unstable character. The other species of this group, *H. sardensis* Juvara-Bals & Witalinski, possesses a smooth presternal plate which is an ancestral trait (Juvara-Bals & Witalinski, 2006).

Among the species examined the specimens of *H. lapalma* sp. n. either have few denticles (3-5) or a smooth presternal plate. In *H. giganteus* sp. n. from Madeira, the presternal plate is smooth. These two species are closely related by characteristics in the gnathotectum and chelicera of the males. I assume that the character state "the presternal plate smooth" is in *H. giganteus* sp. n. a reversal.

## BIOGEOGRAPHY

The mites of the *H. mallorcae* species-group are distributed in the western Mediterranean Basin, in the northern part of Africa, spread along the Atlas Mountains (Morocco), and were also discovered on the Canary and Madeira Islands (Fig. 19). This spatial pattern is due to allopatric speciation by vicariance during the formation of the Western Mediterranean Basin in the Miocene period and by colonizing events in the volcanic Archipelago of Canary.

I try to explain the distribution of the following species:



1 – *H. rifensis* sp. n. and the closely related species *H. lunae* sp. n. and *H. malleus* sp. n.

2 – *H. lawrencei* Hyatt and *H. maritimus* Hyatt.

3 – The four species (*H. canariensis* sp. n., *H. lapalma* sp. n., *H. anaga* sp. n., *H. giganteus* sp. n.) from the Canary and Madeira Islands.

1. *H. rifensis* sp. n. was found in the Rif Mountains (Morocco) and *H. lunae* sp. n. and *H. malleus* sp. n. were collected in south-western Spain between Malaga and Algeciras. This kind of distribution is correlated with the paleogeographical history of the Betico-Rifain Massif. This massif existed as an isolated unit from the late Oligocene to the early Miocene and was later integrated into the northern Africa-Rif Mountains and the South of Spain. The geographical upheavals in the Western Mediterranean area between late Oligocene and late Miocene were described, among others authors, by Pomerol (1973), De Jong (1998) and recently also by Dercourt *et al.* (2000). All the major geological changes led to isolation of populations and speciation in different groups. The localities of the species described herein correspond with the distribution of other terrestrial arthropods with low dispersal abilities. Examples can be found among insects (Jeannel, 1956; Besuchet, 1960; Oosterbroek & Arntzen, 1992; De Jong, 1998), isopods (Vandel, 1969) or scorpions (Gantenbein & Largiadèr, 2003).

2. Another interesting distribution is that of *H. maritimus* Hyatt and *H. lawrencei* Hyatt in Great Britain described by Hyatt (1987). I identified these two species in the Athias-Henriot collection in samples from the northern coast of Spain and from France.

In the same collection I discovered a new species found in leaf litter north of Madrid (Juvara-Bals unpublished). The occurrences of these species can be explained by the existence of several refuge areas on the Iberian Peninsula and in South-West England during the cooler and arid period of the Pleistocene (Reille *et al.*, 1996; Dercourt *et al.*, 2000). Their distribution over a larger area was linked to the expansion of forests. I only mention the existence of *H. maritimus* Hyatt on the islands of Madeira and Tenerife without trying to explain the colonization events due to lack of information (Juvara-Bals unpublished).

3. The occurrence of the *H. canariensis* sp. n., *H. lapalma* sp. n., *H. anaga* sp. n. in the western Canary Islands is the result of secondary invasions and subsequent colonization of the islands from east towards west. A good example of this kind of distribution was given by Pinto *et al.* (1997) for *Drosophila subobscura* Collin, 1936. The distribution of the *Holoparasitus* species is connected to the laurasilva habitat and is similar to that of other soil arthropods like carabid beetles (Machado, 1976). The most frequent species is *H. canariensis* sp. n. found in Great Canary, Gomera, El Hierro, and Tenerife. Small differences in the shape of the male gnathotectum (Fig. 5D-F) or the length of the idiosoma (the specimens from Gomera are smaller than others) have been observed in the population on the western islands. The gland gv2 is also variable: some specimens have two glands others only one.

Tenerife provides an interesting case of geographical isolation in which volcanism played an important role. The three massifs, Anaga in the northeast, Teno in the northwest and Roque del Conde in the south, have previously existed as two or three paleo-islands and became attached to each other by intensive volcanic activity only

two million years ago (Ancochea *et al.*, 1990). I distinguished two species on the island, *H. canariensis* sp. n. and *H. anaga* sp. n. The first was found in the northwest district of Teno and in the Teide National Park (centre of the island), while the second occurs in the northeast and seems to be endemic to the Anaga Mountains. *Holoparasitus anaga* sp. n. differs from *H. canariensis* sp. n. in the shape of the male chelicera, with a large fixed digit, and in having a triangular gnathotectum and a ventral protuberance on trochanter IV in both sexes.

A similar case of speciation in the oribatid genus *Steganacarus* is described in the remarkable work of Salmone and Bernini (2002) who analyzed population structure and divergence on the basis of the mitochondrial DNA variation. These two cases of speciation found in the mites *Steganacarus* and *Holoparasitus* can be considered as intra-island speciation (Emerson & Oromi, 2005).

*Holoparasitus lapalma* sp. n., found only on La Palma Island, is another case of speciation through geographic isolation. La Palma is one of the youngest island of the archipeleago and its first colonization was followed by speciation. This was the case in the beetle genus *Tarphius* Erichson (Emerson & Oromi, 2005).

*Holoparasitus lapalma* sp. n., characterized by special morphological characters, is closely related to *H. giganteus* sp. n. described from Madeira (see discussion in Relationships).

The biogeographic relation between the Canary and Madeira Islands was the subject of many studies, but not all of them arrived at the same conclusion. A. Machado kindly informed me about the dispersal of the carabid beetle *Zargus crotchianus* Wollaston, 1865 and those of the curculionid *Rhopalomesites euphorbiae* (Wollaston, 1845) on both groups of islands, possibly due to the marine current from Madeira to western Canary Islands (Machado, 1992; Machado & Oromi, 2000). According to Trusty *et al.* (2005) the colonization route for the plant genus *Bystropogon* L'Hér. (fam. Lamiaceae) was from Canary to Madeira. Our knowledge of the acarofauna of these Archipelagos is still too poor to explain about the origin of the endemic species *H. lapalma* sp. n.

Much more faunistic data and molecular phylogenetic analyses on material all around the Mediterranean region and in Atlantic Islands, is needed to explain the distribution and the origin of the *H. mallorcae* species-group.

## ACKNOWLEDGEMENTS

I would like to thank P. Schwendinger (MHNG) for providing all the specimens studied in this paper and for facilitating the access to the collections of the Museum. Discussion and further information, on the biogeography of the Western Mediterranean region and the Canary and Madeira Islands was kindly offered by C. Besuchet (MHNG), H. Dirickx (MHNG), C. Meister (MHNG), D. L. Danielopol (Austria), and A. Machado (University La Laguna, Tenerife). Comments and suggestion for improvement of the manuscript made by P. Schwendinger (MHNG) and W. Witalinski (Institute of Zoology, Jagiellonian University, Cracow, Poland) are greatly appreciated. I kindly thank J. Mariaux (MHNG) and the Department of Invertebrates for providing working space and laboratory facilities.

## REFERENCES

- ANCOCHEA, E., FUSTER, A. M., IBARROLA, E., CENDRERO, A., COELLO, J., HERNAN, F., CANTAGREL, J. M. & JAMOND, C. 1990. Volcanic evolution of the island of Tenerife (Canary Islands) in the light of new K-Ar data. *Journal of Volcanology and Geothermal Research* 44: 231-249.
- BESUCHET, C. 1960. Revision du genre *Geopselaphus* Jeann. (Col. Pselaphide). *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* 33(4): 245-263.
- DERCOURT, J., GAETANI, M., VRIELYNCK, B., BARRIER, E., BIJU-DUVAL, B., BRUNET, M. F., CADET, J. P., CRASQUIN, S. Q. & SANDULESCU, M. (eds). 2000. Atlas Peri-Tethys. Paleogeographical maps. *CCGM/CGMW*, Paris, 24 maps and explaining notes: I-XX, 1-269.
- EMERSON, B.C. & OROMI, P. 2005. Diversification of the forest beetle genus *Tarphius* on the Canary Islands and the evolutionary origin of the island endemics. *Evolution* 59(3): 586-598.
- EVANS, G. O. & TILL, W. M. 1979. Mesostigmata mites of Britain and Ireland (Chelicerata: Acari, Parasitiformes). An introduction to their external morphology and classification. *Transactions of the Zoological Society of London* 35: 139-270.
- GANTENBEIN, B. & LARGIADÈR, C. R. 2003. The phylogeographic importance of the strait of Gibraltar as a gene flow barrier in terrestrial arthropods: a case study with the scorpion *Buthus occitanus* as model organism. *Molecular Phylogenetics and Evolution* 28: 119-130.
- HYATT, K. H. 1987. Mites of the genus *Holoparasitus* Oudemans, 1936 (Mesostigmata: Parasitidae) in the British Isles. *Bulletin of the British Museum (Natural History), Zoology series* 52(4): 139-164.
- JEANNEL, R. 1956. Les Psélaphides de l'Afrique du Nord. Essai de biogéographie berbère. *Mémoires du Muséum national d'Histoire Naturelle, série A* 14: 1-233.
- JONG, H. DE. 1998. In search of historical biogeographic patterns in the western Mediterranean terrestrial fauna. *Biological Journal of the Linnean Society* 65: 99-164.
- JUVARA-BALS, I. 1975. Sur le genre *Holoparasitus* Oudemans, 1936 et sur certains caractères morphologiques de la famille Parasitidae Oudemans (Parasitiformes). *Acarologia* 17: 384-409.
- JUVARA-BALS, I. & WITALINSKI, W. 2000. Description of five new species of *Holoparasitus* s. str. with redescription of *H. apenninorum* (Berlese, 1906) and *H. cultriger* (Berlese, 1906) from Italy and Spain (Acari, Gamasida, Parasitidae). *Revue suisse de Zoologie* 107: 3-30.
- JUVARA-BALS, I. & WITALINSKI, W. 2006. Two new species of the genus *Holoparasitus* Oudemans from the Mediterranean Basin-Algeria and Sardinia (Acari: Gamasida: Parasitidae). *Genus* 17(3): 437-448.
- LINDQUIST, E. E. 1994. Some observations on the chaetotaxy of the caudal body region of gamasinae mites (Acari: Mesostigmata), with a modified notation for some ventrolateral body setae. *Acarologia* 35: 323-326.
- LINDQUIST, E. E. & EVANS, G. O. 1965. Taxonomic concepts in the Ascidae, with a modified setal nomenclature for the idiosoma of the Gamasina (Acarina, Mesostigmata). *Memoir of the entomological Society of Canada* 47: 1-64.
- MACHADO, A. 1976. On the Canary Islands'laurisilva, with special references to the ground-beetles (Coleoptera, Caraboidea) (pp. 347-411). In: KUNKEL, J. (ed.). Biogeography and ecology in the Canary Islands. *Dr. W. Junk b.v. Publisher. The Hague*. 347-411.
- MACHADO, A. 1992. Monographia de los Carábidos de las islas Canarias (Insecta, Coleoptera). *Instituto de Estudios Canarios, La Laguna*, 734 pp.
- MACHADO, A. & OROMI, P. 2000. Elenco de los coleópteros de las islas Canarias. Catalogue of the coleoptera of the Canary Islands. Monographia 70. *Instituto de Estudios Canarios, La Laguna*, 307 pp.

- MICHERDZINSKI, W. 1969. Die Familie Parasitidae Oudemans 1901 (Acarina, Mesostigmata). *Panstwowe Wydawnictwo Naukowe, Krakow*, 660 pp.
- OOSTERBROEK, P. & ARNTZEN, J. W. 1992. Area-cladograms of Circum-Mediterranean taxa in relation to Mediterranean palaeogeography. *Journal of Biogeography* 19: 3-20.
- PINTO, F. M., BREHM, A., HERNANDEZ, M., LARRUGA, J. M., GINZALEZ, A. M. & CABRERA, V. M. 1997. Population genetic structure and colonization sequence of *Drosophila subobscura* in the Canaries and Madeira Atlantic Islands as inferred by autosomal sex-linked and mtDNA traits. *Journal of Heredity* 88: 108-114.
- POMEROL, C. 1973. Stratigraphie et Paléogeographie. Ere cénozoïque (Tertiaire et Quaternaire). *Doin éditeurs. Paris*: 269 pp.
- REILLE, M., ANDRIEU, V. & BEAULIEU DE, L. 1996. Les grands traits de l'histoire de la végétation des montagnes méditerranéennes occidentales. *Ecologie* 27(3): 153-169.
- SALOMONE, N. & BERNINI, F. 2002. Mitochondrial DNA variation and phylogeography of *Steganacarus* on Tenerife (Canary Islands) (pp. 35-39). In: BERNINI, F., NANNELLI, R., NUZZACI, G. & LILLO DE, E. (eds). *Acarid Phylogeny and Evolution. Adaptations in mites and ticks. Kluwer Academic Publishers, the Netherlands*.
- TRUSTY, J. L., OLMSTEAD, R. G., SANTOS-GUERRA, A., SA-FONTINHA, S. & ORTEGA, J. F. 2005. Molecular phylogenetics of the Macronesian-endemic genus *Bystropogon* (Lamiaceae): palaeo-islands, ecological shifts and interisland colonizations. *Molecular Ecology* 14: 1177-1189.
- VANDEL, A. 1969. Les Isopodes terrestres de la Sicile. *Atti della Accademia Gioenia di Scienze naturali in Catania* 1: 1-59.
- WITALINSKI, W. 1994a. *Holoparasitus (Holoparasitus) dallaii* sp. n., a new gamasid mite from Sardinia, Italy (Acari: Pergamasidae). *International Journal of Acarology* 19: 349-354.
- WITALINSKI, W. 1994b. Two new *Holoparasitus* species from Italy and Poland (Acari: Gamasida: Pergamasidae). *Genus* 5: 215-222.
- WITALINSKI, W. & SKORUPSKI, M. 2002. Genus *Holoparasitus* Oudemans, 1936 in Berlese Acaroteca (Acari: Gamasida: Parasitidae). Part I. *Redia* 85: 37-60.
- WITALINSKI, W. & SKORUPSKI, M. 2003. Genus *Holoparasitus* Oudemans, 1936 in Berlese Acaroteca (Acari: Gamasida: Parasitidae). Part II. *Redia* 86: 17-22.